Series 1945, No. 3 Issued August 1962

SOIL SURVEY

San Juan Area Utah

OUR SOIL ★ OUR STRENGTH

This is the last soil survey of the 1945 series

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
UTAH AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

THIS SOIL SURVEY of the San Juan Area, Utah, will serve various groups of readers. It will help farmers and ranchers in planning the kind of management that will protect their soils and provide good yields, and it will add to the fund of knowledge about soils.

Soil scientists studied and described the soils and made a map that shows the kind of soil everywhere in the survey area. The base for the soil map is a set of aerial photographs that show fields, woods, roads, and many other landmarks.

Locating the soils

Use the index to map sheets to locate areas on the large map. The index is a small map of the Area that shows the location of each sheet of the large map. When the correct sheet of the large map is found, it will be seen that boundaries of the soils are outlined in red, and that there is a red symbol for each soil. Suppose, for example, an area on the map has the symbol AbD. The legend for the detailed map shows that this symbol identifies Abajo loam, 0 to 10 percent slopes. This soil and all others mapped in the Area are described in the section "Descriptions of Soils."

Finding information

The report has special sections for different groups of readers. The section "General Nature of the Area," which discusses the physiography, relief, drainage, and climate, will be of interest mainly to those not familiar with the Area.

Farmers and ranchers and those who work with farmers and ranchers can learn about the soils in the section "Descriptions of Soils," and then go to the section "Use and Management of Soils." In this way they first identify the soils on their farms or ranches and then learn how these soils can be managed and what yields can be expected. The soils suitable for dryland farming are grouped by capability units; that is, groups of soils that need similar management and respond in about the same way. For example, Abajo loam, 0 to 10 percent slopes, is in capability unit IIIc-1 and in the Upland Loam and Upland Loam (Pinyon-Juniper) range sites. The management needed for this soil, if it is used for cultivated crops, will be found under the heading, Capability Unit IIIc-1, in the section "Management by Capability Units." The management needed if the soil is used for range will be found in the discussions of the Upland Loam and Upland Loam (Pinyon-Juniper) range sites, in the section "Range Management." A list just before the map sheets gives the name of each soil, the page where the soil is described, the symbol of the capability unit in which the soil has been placed, and the page where the capability unit is described. It also gives the range site and the page on which the range site is discussed.

Soil scientists and others interested in the nature of soils will find information about how the soils were formed and how they are classified in the section "Formation, Classification, and Morphology of Soils."

People interested in the woodlands on their range will find statements about woodlands in the section "Range Management."

* * * * *

This soil survey was made as a part of the technical assistance furnished by the Soil Conservation Service to the San Juan County Soil Conservation District, which was organized in 1940. The soils in the Area were mapped during the period 1940 to 1943, and fieldwork for the survey was reviewed and revised in 1955 and 1956. Unless otherwise indicated, all statements in the report refer to conditions at the time fieldwork was in progress.

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SOIL SURVEY OF THE SAN JUAN AREA, UTAH

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UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH THE UTAH AGRICULTURAL EXPERIMENT STATION

THE SAN JUAN AREA is a part of San Juan County. It is in the southeastern corner of Utah (fig. 1), at the point where the four States of Arizona, Colorado, New Mexico, and Utah meet. San Juan County is bounded by Colorado on the east and by Arizona on the south. The Colorado River flows diagonally, in a southwesterly direction, along its western side. Part of the Navajo Indian Reservation occupies the irregularly shaped area south of the San Juan River.

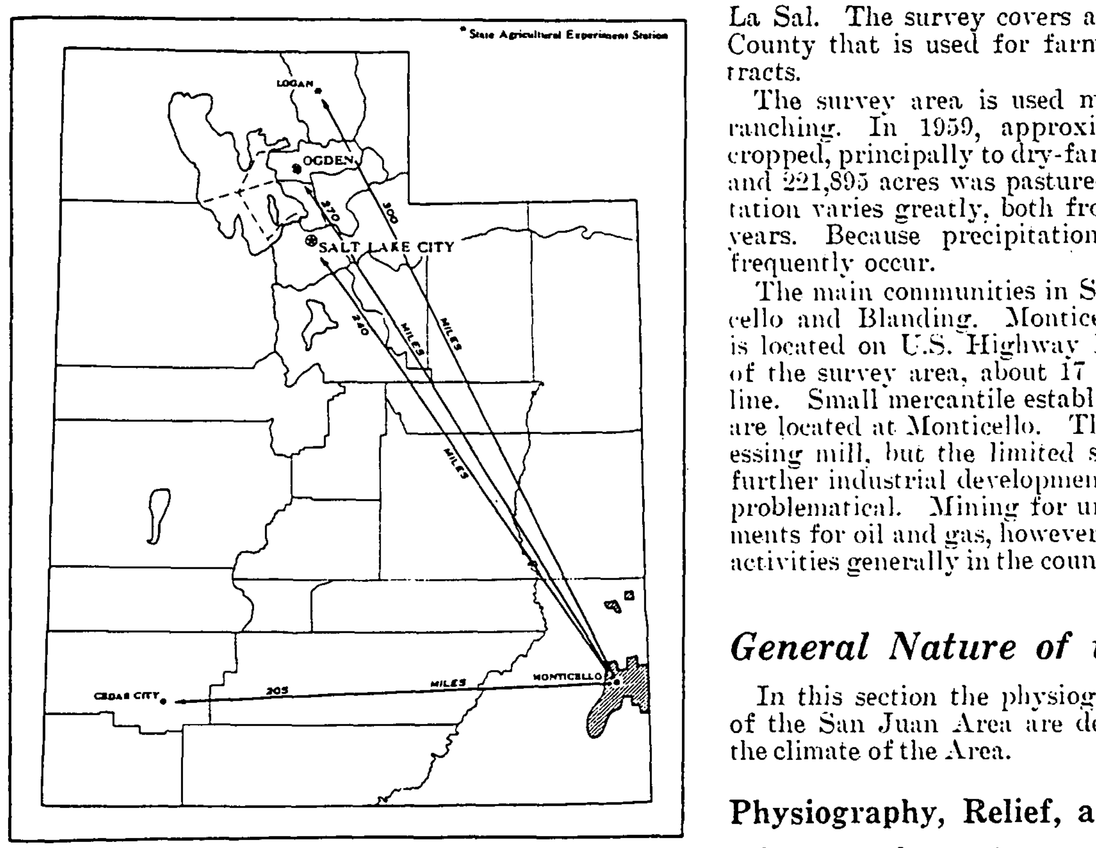

Figure 1.—Location of the San Juan Area in Utah.

All of the area that was surveyed is north of the San Juan River. It covers 351,227 acres, which is less than 10 percent of the total acreage in San Juan County. The survey area extends from approximately 8 miles south of Blanding to 12 miles north of Monticello, and from the Colorado State line on the east to the boundary of the Manti-La Sal National Forest, near the base of the Abajo Mountains, on the west. It also includes two small tracts about 40 miles north of Monticello, near La Sal and Old La Sal. The survey covers all of the land in San Juan County that is used for farming, except small, isolated tracts.

The survey area is used mainly for dryfarming and ranching. In 1959, approximately 118,000 acres was cropped, principally to dry-farmed wheat and pinto beans, and 221,895 acres was pastured. The amount of precipitation varies greatly, both from year to year and within years. Because precipitation is erratic, crop failures frequently occur.

The main communities in San Juan County are Monticello and Blanding. Monticello is the county seat. It is located on U.S. Highway No. 160 in the central part of the survey area, about 17 miles west of the Colorado line. Small mercantile establishments and several motels are located at Monticello. There is also a uranium processing mill, but the limited supply of water makes any further industrial development in this part of the county problematical. Mining for uranium, and recent developments for oil and gas, however, have increased commercial activities generally in the county.

General Nature of the Area

In this section the physiography, relief, and drainage of the San Juan Area are described. Also described is the climate of the Area.

Physiography, Relief, and Drainage

San Juan County is a part of the Colorado Plateaus Province. Much of the county covered by the survey is deeply dissected by canyons formed by tributaries of the Colorado and San Juan Rivers. Most of the survey area is on the rather extensive tableland known as Sage Plain. The surface of the plain is made up of undulating to rolling, low hills of shale and eolian deposits of variable thickness. The elevation of the plain ranges from 5,000 to 7,000 feet, but, in the part within the survey area, the elevation is between 6,000 and 7,000 feet. The southern part

[1] Ray L. Frost, Glade M. Wright, Ossian G. Smith, Lawrence Doherty, Clifford L. Merrell, and Howard A. Stokes, Soil Conservation Service, assisted with the field survey.

of the plain is deeply dissected by streams that deepen as they flow toward the San Juan River through steep-walled canyons that are 100 to 500 feet deep.

The remnants of the plain, which lie between the steep-walled canyons, are locally called points. These are covered by a mantle of wind-deposited sediments that range from 2 to 10 feet or more in thickness. The soils on these sediments are among the most productive in the Area.

The somewhat oval-shaped Abajo Mountains rise on the west of Sage Plain to an elevation of 11,445 feet. These mountains are not precipitous, nor are they rugged. The rocks are typically bluish gray and are porphyritic. They range between trachyte and andesite in composition. Several permanent streams that constitute the main water supply for Monticello and Blanding have their sources in the Abajo Mountains. The water from these streams is also used to irrigate a relatively small acreage of land near Monticello, Blanding, and other areas.

The La Sal Mountains are in the northeastern part of San Juan County and in Colorado. Like the Abajo Mountains, they give rise to several streams, some of which serve as a source of water for La Sal and Old La Sal.

The main creeks draining the Area to the south are Montezuma, in the central part of the Area, and Recapture and Cottonwood, in the southwestern part. Coyote, Hatch, and East Canyon Washes drain the Area toward the north. These washes have less precipitous banks than the drainageways in the southern part of the Area.

Climate

The climate in the San Juan Area is mainly dry, subhumid continental. The seasons are well defined, and there is a fairly wide daily range in temperature. Only in the extreme southern part of the Area, south of Blanding, is the climate semiarid. Table 1 gives temperature and precipitation, compiled from records of the United States Weather Bureau at Blanding, in the southern part of the Area, and at Monticello, in the northwestern part.

The difference in elevation causes the temperature to be slightly lower at Monticello than at Blanding, and it also causes the growing season to be shorter. At both stations, January is the coldest month. Short spells in which the temperature is below zero are common in January and

TABLE 1.—*Temperature and precipitation at two stations in the San Juan Area, Utah*

[Blanding, San Juan County, elevation, 6,036 feet]

Month	Temperature[1] Average	Temperature[1] Absolute maximum	Temperature[1] Absolute minimum	Precipitation[2] Average	Precipitation[2] Driest year (1950)	Precipitation[2] Wettest year (1909)	Precipitation[2] Average snowfall
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December	30.2	65	−11	1.35	0.07	6.43	11.7
January	26.6	62	−17	1.05	.75	3.65	9.8
February	32.4	67	−23	1.20	1.00	2.70	7.3
Winter	29.7	67	−23	3.60	1.82	12.78	28.8
March	39.2	78	2	1.08	.55	.90	4.3
April	48.0	85	10	.94	.06	(3)	1.3
May	56.7	92	18	.76	.41	.55	.3
Spring	48.0	92	2	2.78	1.02	1.45	5.9
June	65.7	98	28	.58	.06	0	(3)
July	72.3	103	36	.99	.81	2.00	0
August	70.5	101	40	1.24	.09	3.78	0
Summer	69.5	103	28	2.81	.96	5.78	(3)
September	62.7	95	20	1.47	1.34	1.40	0
October	51.8	90	12	1.29	0	.40	.4
November	38.6	71	−7	.82	.17	2.80	2.6
Fall	51.0	95	−7	3.58	1.51	4.60	3.0
Year	49.6	103	−23	12.77	5.31	24.61	3.77

[Monticello, San Juan County, elevation, 7,066 feet]

Month	Temperature[1] Average	Temperature[1] Absolute maximum	Temperature[1] Absolute minimum	Precipitation[2] Average	Precipitation[2] Driest year (1950)	Precipitation[2] Wettest year (1911)	Precipitation[2] Average snowfall
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December	27.3	62	−14	1.36	0.38	1.60	15.2
January	24.2	57	−14	1.25	.52	.75	17.0
February	28.9	60	−21	1.44	.55	3.73	14.7
Winter	26.8	62	−21	4.05	1.45	6.08	46.9
March	35.3	67	−2	1.57	.71	1.04	11.2
April	45.1	79	4	1.09	.37	.36	3.7
May	52.6	85	14	.87	.19	0	.6
Spring	44.3	85	−2	3.53	1.27	1.40	15.5
June	61.7	97	27	.72	.06	.91	(3)
July	68.0	96	35	1.51	1.73	3.95	(3)
August	66.2	94	37	1.88	.66	2.24	0
Summer	65.3	97	27	4.11	2.45	7.10	(3)
September	58.9	91	21	1.62	1.10	2.91	(3)
October	48.9	82	11	1.86	0	6.31	.6
November	36.6	70	−2	1.09	.29	.10	5.2
Fall	48.1	91	−2	4.57	1.39	9.32	5.8
Year	46.1	97	−21	16.26	6.56	23.90	68.2

[1] Blanding: Average temperature based on a 43-year record, through 1955; highest temperature on a 44-year record; and lowest temperature on a 45-year record, through 1952. Monticello: Average temperature based on a 32-year record, through 1955; highest temperature on a 33-year record and lowest temperature on a 34-year record, through 1952.

[2] Blanding: Average precipitation based on a 47-year record, through 1955; wettest and driest years based on a 50-year record, in the period 1905–55; snowfall based on a 39-year record, through 1952. Monticello: Average precipitation based on a 33-year record, through 1955; wettest and driest years based on a 37-year record, in the period 1902–55; snowfall based on a 35-year record through 1952.

[3] Trace.

February. The temperature is mild in summer; at Monticello, the average temperature in summer is 65.3° F., and at Blanding, it is 69.5°.

The average length of the growing season at Monticello is 129 days, or from May 25, the date of the last killing frost in spring, to October 1, the date of the first frost in fall. At Blanding, the average length of the growing season is 147 days, or from May 12, the date of the last killing frost in spring, to October 6, the date of the first frost in fall. In any given year the length of the growing season may vary considerably from the average. In a large acreage in the northeastern part of the Area, the growing season is somewhat shorter than at Monticello. Locally, within that general area, air drainage is poor. Such small areas are called frost pockets. Killing frosts are more frequent in these frost pockets than in surrounding areas.

The average annual precipitation at Monticello is 16.26 inches, and at Blanding, 12.77 inches. The largest amount of precipitation is during August, September, and October, and the least, during May and June. Fluctuations in precipitation are common, both from month to month and from year to year.

Data kept by the Weather Bureau on the velocity of the wind are not available for this Area. It would appear, however, that wind is an important climatic factor. The windiest part of the year is in spring and early in summer. The prevailing winds are usually dry and blow from the southwest.

How Soils are Named, Mapped, and Classified

Soil scientists made this survey to learn what kinds of soils are in the San Juan Area, where they are located, and how they can be used.

They went into the Area knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the Area, they observed steepness, length, and shape of slopes; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug or bored many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down to the rock material that has not been changed much by leaching or by deep-rooted plants or trees.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to uniform procedures. To use this report efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Generally, each soil series is named for a town or other geographic feature near the place where a soil of that series was first described and mapped. Blanding and Monticello, for example, are the names of two soil series in the San Juan Area. All the soils in the United States having the same series name are essentially alike in natural characteristics.

Many soil series contain soils that are alike, except for texture of their surface layer. According to this difference in texture, separations known as soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. For example, Ackmen loam and Ackmen silt loam are two soil types in the Ackmen series. The difference in texture of their surface layers is apparent from their names.

Some soil types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into soil phases. The name of a soil phase indicates a feature that affects management. For example, Ackmen loam, 0 to 6 percent slopes, is one of several phases of Ackmen loam, a soil type that ranges from nearly level to sloping.

After a fairly detailed guide for classifying and naming the soils had been worked out, the soil scientists drew soil boundaries on aerial photographs. They used photos for their base map because photos show woodlands, buildings, field borders, trees, and similar details that help greatly in drawing boundaries accurately. The soil map in the back of this report was prepared from these aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientist has a problem of delineating areas where different kinds of soils are so intricately associated and so small in size that it is not practical to show them separately on the map. Therefore, he shows this association of soils as one mapping unit and calls it a soil complex. Ordinarily, a soil complex is named for the major soil series in it, for example, Monticello-Hovenweep complex. Also, in most mapping, there are areas to be shown that are so rocky, so shallow, or so frequently worked by wind and water that they cannot be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Sandstone rockland, sloping, or Sandstone rockland, steep, and are called land types rather than soils.

Only part of the soil survey was done when the soil scientist had named and described the soil series and mapping units and had shown the location of the mapping units on the soil map. The mass of detailed information he had recorded then needed to be presented in different ways for different groups of users, among them farmers, ranchers, and managers of woodlands and rangelands.

To do this efficiently, he had to consult with persons in other fields of work and jointly prepare with them groupings that would be of practical value to different users. Such groupings are the capability classes, subclasses, and units, designed mainly for those interested in producing crops and tame pasture, and range sites, for those using large tracts of native vegetation.

General Soil Areas

Nine general soil areas are in the San Juan Area. These are shown on the colored general soil map at the back of the report.

These nine areas make up the following three main regions:

1. Upland soils of dry subhumid regions.
2. Upland soils of semiarid regions.
3. Soils of drainageways in semiarid and dry subhumid regions.

The nine general areas, or soil patterns, shown on the map are not detailed enough to allow for planning detailed management of a farm or ranch. Each area contains several different kinds of soils that occur in a characteristic pattern. The pattern in this Area is related to the nature of the soil materials and to the climate.

The map is useful to those who want a general idea of the soils, who want to compare different parts of the Area, or who want to locate large tracts suitable for some particular kind of farming or other broad land use. It does not show accurately the kinds of soils on a single farm or on a small tract.

Upland Soils of Dry Subhumid Regions

Upland soils of dry subhumid regions occupy about 83 percent of the San Juan Area. The following general soil areas are in this group:

1. Deep and moderately deep soils in wind-deposited materials: Monticello, Northdale, Abajo, Hovenweep.
2. Deep and moderately deep soils in wind-deposited materials in areas that have low rainfall and are subject to damage by frost: Scorup, Hovenweep, Northdale, Monticello.
3. Deep to shallow soils on shale: Hovenweep, Lockerby, Ucolo, Menefee.
4. Cobbly soils: Abajo, Menefee, Pack, Scorup.
5. Shallow, very rocky soils: Montvale.

1. Deep and moderately deep soils in wind-deposited materials: Monticello, Northdale, Abajo, Hovenweep

This general soil area occupies about 27 percent of the San Juan Area. The Monticello and Northdale soils are the most extensive, and the Abajo and Hovenweep soils occupy a smaller acreage.

The soils in this general area are on undulating to rolling uplands that have been dissected by the channels of intermittent streams. In many places streams have cut canyons that are as much as several hundred feet deep. The canyons improve air drainage and lengthen the frost-free period of the adjacent uplands. Records of precipitation kept by the U.S. Weather Bureau at Monticello are representative for this general area. They show that the annual precipitation is 12 inches, or more, 75 percent of the time.

The Monticello and Northdale soils are well drained and medium textured. The Monticello soils have formed in deep deposits of wind-deposited materials, and the Northdale soils, in similar, but moderately deep, deposits that overlie sandstone. The Abajo soils are well drained, but they are moderately fine textured to fine textured. They have formed in cobbly alluvium that is covered in places by a thin mantle of wind-laid materials. The Hovenweep soils are moderately deep and well drained and are medium to moderately fine textured. They have formed in wind-deposited materials underlain by shale.

The soils of this general soil area are suitable for dry-farming. Small tracts in the vicinity of Monticello and Old La Sal are irrigated. The small amount of water that is available early in the growing season is used for irrigation.

2. Deep and moderately deep soils in wind-deposited materials in areas that have low rainfall and are subject to damage by frost: Scorup, Hovenweep, Northdale, Monticello

The soils in this general soil area are in a region of low rainfall. They occupy about 20 percent of the San Juan Area. The Scorup soils and the low rainfall phases of the Northdale and Monticello and of the Monticello-Hovenweep complex are the most extensive. These soils are on undulating to rolling uplands that have been dissected by the channels of intermittent streams. The streams have cut deep canyons, particularly in the vicinity of Blanding.

Beginning about 4 miles east of Monticello and extending to the Colorado State line, frost is a hazard, and crops, especially pinto beans, cannot be grown extensively. Records of precipitation kept by the U.S. Weather Bureau at Blanding are representative for this general area. They show that 40 percent of the time the annual precipitation ~~is less~~ than 12 inches.

The Scorup soils are in the vicinity of La Sal. They are moderately deep to deep and are well drained and medium textured. The Scorup soils have formed in a thin deposit of wind-laid materials that overlie alluvium containing gravel and lime. The Hovenweep soils are moderately deep and well drained. They are medium textured to moderately fine textured and have formed in wind-deposited materials underlain by shale. The low rainfall phases of the Northdale soils are also moderately deep and well drained. They are medium textured and have formed in deposits of wind-laid materials underlain by sandstone. The low rainfall phases of the Monticello soils have formed in deep deposits of wind-laid materials. They are deep, well drained, and medium textured.

The soils in this general area are principally near Blanding and northeast of Monticello, and they extend to the Colorado State line. Other areas are in the vicinity of La Sal.

These soils are best suited to grass, but some areas can be used to grow winter wheat. Small tracts near La Sal and Blanding are irrigated. The small amount of water that is available early in the growing season is used for irrigation.

3. Deep to shallow soils on shale: Hovenweep, Lockerby, Ucolo, Menefee

The soils in this general area occupy about 11 percent of the San Juan Area. They overlie shale. The Lockerby soils and the low rainfall phases of the Hovenweep soils are the most extensive. They are on undulating uplands. The Ucolo soils, which are less extensive, are in swales, and the Menefee soils are on the rolling ridges, which are interspersed throughout this general area. Because of the low rainfall and the likelihood of frost early in fall, growing beans is hazardous on these soils. The annual precipitation is less than 12 inches 40 percent of the time. The Hovenweep soil in this general soil area is moderately deep and is well drained. It is medium textured to moderately fine textured and has formed in deposits of wind-laid materials underlain by shale. The Lockerby soils are moderately deep, moderately well drained, and fine textured; the Ucolo soils are deep, moderately well drained, and fine textured; and the Menefee soils are shallow, well drained, and moderately fine textured. The soils have all been strongly influenced by parent material weathered from shale, but some wind-deposited material is evident, especially in the Hovenweep soils.

The soils in this general area are suited to grass and can be used as range or range woodland. A small acreage is used for dryland wheat.

4. Cobbly soils: Abajo, Menefee, Pack, Scorup

The soils in this general area occupy about 3 percent of the San Juan Area. Cobbly soils of the Abajo, Menefee, Pack, and Scorup series predominate. The Abajo and Menefee soils are on long, narrow ridges near Monticello; the Scorup soils are on alluvial fans near La Sal; and the Pack soils are along drainageways near Old La Sal.

The soils are of only minor extent and are not cultivated. If properly managed, they are productive as range or as range woodland.

5. Shallow, very rocky soils: Montvale

This general soil area occupies about 22 percent of the San Juan Area. It is made up of the Montvale soil, which is shallow to very shallow and very rocky. There are many outcroppings of sandstone throughout this general area. Angular fragments of flagstone are on the surface and throughout the profile. The topography is broken. Near the canyons the slopes are steeper than elsewhere. The climate is dry subhumid.

This land is not cropped. Its best use is for range and range woodland.

Upland Soils of Semiarid Regions

Approximately 12 percent of the San Juan Area is made up of upland soils of semiarid regions. The following general soil areas are in this group:

6. Deep soils in wind-deposited materials: Blanding.
7. Shallow, very rocky soils: Mellenthin.
8. Sandstone rockland.

6. Deep soils in wind-deposited materials: Blanding

This general soil area occupies about 2 percent of the San Juan Area. It is made up of the Blanding soil, which has formed in deep wind-deposited materials. The soil occurs in undulating to rolling uplands that are dissected by the channels of intermittent streams. Some of the channels have formed deep canyons. The Blanding soil is well drained and medium textured.

No weather stations are located in this general soil area. The Blanding soil is suitable for range, but dryfarming has been unsuccessful.

7. Shallow, very rocky soils: Mellenthin

This general soil area occupies about 2 percent of the San Juan Area. It is made up of the Mellenthin soil, which is shallow to very shallow. This soil has many outcroppings of sandstone. It occurs in the southern part of the Area, where the topography is broken and the climate is semiarid. The soil is not cropped but is suitable for range and range woodland.

8. Sandstone rockland

This general area occupies about 8 percent of the San Juan Area. It is made up of steep sandstone rockland. This steep rockland is very shallow and rocky, and there are many outcroppings of bedrock. The topography consists mainly of steep, broken canyons that dissect the upland areas. This steep land has limited value for range and for range woodland.

Soils of Drainageways in Semiarid and Dry Subhumid Regions

Approximately 5 percent of the San Juan Area is made up of soils of drainageways in semiarid and dry subhumid regions. The following is the general soil area in this group:

9. Deep soils of drainageways: Ackmen, Pack, Shay, Vega

This general soil area occupies about 4 percent of the San Juan Area. It is made up of deep soils in drainageways and on alluvial flood plains. The principal soils are the Ackmen, Pack, Shay, and Vega. The areas in which these soils occur extend eastward from the Abajo Mountains and south and southeast from the La Sal Mountains. The soils are medium textured to fine textured and are well drained to imperfectly drained. In many places they are gullied. In some places the soils are on flood plains that are wide enough to be cultivated; the largest such area is near La Sal. Other smaller areas are at Old La Sal, north of Blanding, and near Monticello.

The areas of these soils are small, and they are dissected in many places by the channels of intermittent streams. Some of the areas are irrigated by using the small amount of water that is available early in the growing season.

Use and Management of Soils

This section has three main parts. In the first the system of capability classification used by the Soil Conservation Service is explained. In the second the management of soils suitable for dry-farmed crops is described and a discussion of yields is given. In the third the management of soils suitable for range, or for woodland used as range, is described. In addition to the suggestions given here, the farmer or rancher can obtain help in managing his farm or ranch by consulting a local representative of the Soil Conservation Service or the county extension agent.

Capability Groups of Soils

The capability classification is a grouping that shows, in a general way, how suitable soils are for most kinds of farming. It is a practical grouping based on limitations of the soils, on the risk of damage when they are used, and on the way they respond to treatment.

In this system all the kinds of soil are grouped at three levels—the capability class, subclass, and unit. The eight capability classes, the broadest grouping, are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the remaining classes have progressively greater natural limitations. In class VIII are soils and land types so rough, shallow, or otherwise limited that they do not produce harvestable yields of crops, grazing, or wood products.

Subclasses are used to indicate major kinds of limitations within the classes. Within most of the classes, there can be as many as four subclasses. The subclass is indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless a close-growing cover of plants is maintained; *w* means that water in or on the soil will interfere with the growth of plants or with cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, stony, or has low fertility that is difficult to correct; and *c*, is used to indicate that the chief limitation is climate.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils in it have little or no susceptibility to erosion but have other limitations that limit their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units. These are groups of soils enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for many statements about management of soils. Capability units are generally identified by numbers assigned locally, for example IIIc-3.

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of their permanent limitations. The soils suitable for cultivation have been grouped and are described in the list that follows. Soils not cultivated or that are not suitable for cultivation have been grouped into range sites. Most of the capability units for soils suited to cultivation are listed under the climatic subclass IIIc or IVc, which indicates that climate is the dominant limitation of the soils. In addition, most of the soils are limited by risk of erosion or by their moisture-holding capacity. The capability unit in which the hazard of erosion is the dominant limitation is listed under the subclass IVe.

The soils in capability units IIIc-1, IIIc-2, IIIc-3, and IVe-1 occur in the part of the Area that receives about the same amount of moisture as is received at the Monticello Weather Station. The soils in capability units IVc-1, IVc-2, IVc-3, and IVc-4 occur in the part of the Area that receives about the same amount of moisture as is received at the Blanding Weather Station (see table 1).

Class III. Soils that have severe limitations that reduce the choice of plants, or that require special conservation practices, or both.
- Subclass IIIc.—Soils that have severe limitations because of climate.
  - Unit IIIc-1.—Deep, well-drained soils that have slow to moderate permeability and a high available moisture-holding capacity.
  - Unit IIIc-2.—Moderately deep, well-drained soil that is moderately permeable and has a moderate available moisture-holding capacity.
  - Unit IIIc-3.—Deep, well-drained or imperfectly drained soils that have formed in alluvial sediments and have a high available moisture-holding capacity.

Class IV. Soils that have very severe limitations that restrict the choice of plants, or that require very careful management, or both.
- Subclass IVe.—Soils subject to very severe erosion if they are cultivated and not protected.
  - Unit IVe-1.—Moderately deep, well-drained soil that is moderately permeable and has a moderate available moisture-holding capacity.
- Subclass IVc.—Soils that have very severe limitations because of climate.
  - Unit IVc-1.—Deep and moderately deep, well-drained soils that have moderate to slow permeability and a moderate to high available moisture-holding capacity.
  - Unit IVc-2.—Deep, well-drained to imperfectly drained soils that are in swales and that have a high available moisture-holding capacity.
  - Unit IVc-3.—Moderately deep, well-drained soils that have moderate to slow permeability and a moderate available moisture-holding capacity.
  - Unit IVc-4.—Moderately deep, well drained or moderately well drained soils that have slow to very slow permeability and a moderate available moisture-holding capacity.

Management of Dry Land

In this section, the soils suitable for dryfarming are grouped in capability units and each capability unit is described. Under each unit suggestions concerning suitable crops, cropping systems, and management practices are given. Also given are essential dryfarming practices that apply to the soils of all of the capability units; that is, stubble mulching, stripcropping or contour stripcropping, chiseling, and use of grassed waterways. These practices are used to protect the soils from further erosion.

At the time the Area was surveyed, more than half of the soils had been damaged by sheet erosion. In many places the effects of sheet erosion have since been obliterated by tillage because the shallow rills, among the first signs of erosion, are easily filled in by plowing, rodweeding, or other tillage operations. When the next rain comes, however, another rill forms. Each time this happens, many tons of soil are moved down the slope and eventually out of the field and away from the farm. In places, fans of soil deposited at the lower ends of fields indicate serious erosion.

In much of the Area, soils that have been damaged by sheet erosion also have gullies of varying depth and frequency. The shallow or moderately deep, rolling soils in drainageways between the hills have been washed away entirely in many places, and the sandstone or shale is exposed. The sandstone or shale is hard enough so that gullying does not continue downward, but cuts into the soil at the sides of the gully. In the deep soils, the depth of the cutting is controlled only by the grade of the stream into which the gully flows. If the grade is steep, a deep, steep-sided gully forms, in places reaching to a depth of 20 to 30 feet (fig. 2).

Since this survey was made, an estimated total of more than 50,000 acres, not previously used for cultivated crops, has been put under cultivation. Clearing the cover of pinyon, juniper, and sagebrush has destroyed the natural windbreaks and has opened the way to a sharp increase in wind erosion. The practice of preparing a fine seedbed and then leaving the ground bare also increases the susceptibility of the soil to erosion by wind. As a result, the effects of wind erosion are becoming more apparent throughout the Area, and stubble mulching, stripcropping, and other practices are needed to protect the soils.

Stubble mulching is a system of tilling, planting, cultivating, and harvesting that keeps crop residues on the surface of the soil. Wherever runoff or erosion occurs, operations need to be on the contour, or crosswise to the prevailing slope. Stubble mulching helps to control erosion by wind and water. It also prevents sealing and crusting of the soil; increases the ability of the soil to absorb water; reduces the evaporation of moisture; and helps to maintain the supply of organic matter in the soil.

Stripcropping consists of growing different crops in alternate strips to reduce erosion from water and wind. The width of the strips may vary, depending on the seriousness of the hazard of erosion. To reduce erosion by water on slopes greater than 6 percent, stripcrop on the contour, or across the slope (fig. 3). On slopes of 6 percent or less, where erosion by wind is a greater hazard than erosion by water, wind stripcrop, or grow crops in strips that run approximately at right angles to the direction of prevailing winds.

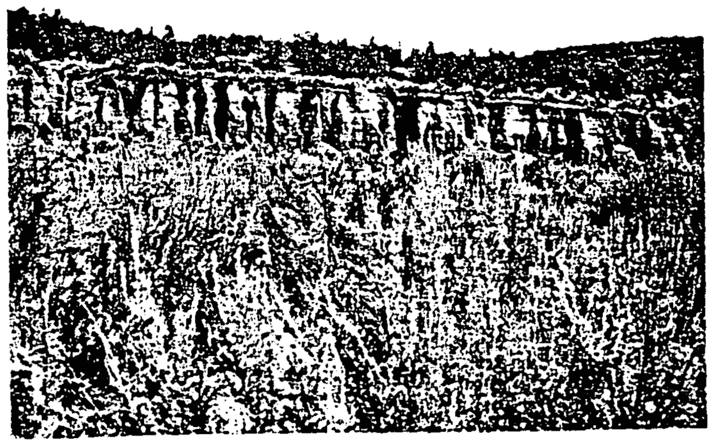

Figure 2.—Deep gully in Ackmen loam, 0 to 10 percent slopes, severely eroded.

Figure 3.—A field in which winter wheat has been planted in strips on the contour, alternating with strips of fallow.

Chiseling consists of tilling the subsoil, or the soil horizon below the normal plow depth, to loosen the lower layers and to break up a plowsole. It is best done in fall when the soil is dry. The plowsole is at a different depth in different soils. In some of the soils, it is as deep as 10 inches, and in others it is at a depth of only 4 inches.

Grassed waterways are constructed, or shaped, to carry off runoff that would otherwise cause erosion. The waterways are protected by vegetation. They should be used as needed to provide for the disposal of water and to help control erosion. The need for grassed waterways varies. One field may need only one grassed waterway, and another field, several.

Management by capability units

The soils in the San Juan Area that can be used to grow dry-farmed crops have been placed in eight capability units. The soils in a given capability unit have about the same limitations and susceptibility to damage, need about the same management, and respond to management in about the same way. In the following pages each capability unit is described, the soils in it are named, and management for the group is suggested.

CAPABILITY UNIT IIIc-1

The soils in this capability unit are deep and well drained. They have slow to moderate permeability and have a high available moisture-holding capacity. In places they contain gravel and cobbles below a depth of 20 inches. Runoff is slow to medium, depending on the intensity of the precipitation and on the amount of frost in the soil when the snow melts. The soils are easy to till, but a plowsole forms if they are cultivated when too wet. They are moderately susceptible to water and wind erosion. Slopes range from 0 to 10 percent, and in most places the soils are undulating to rolling. The soils in this unit are—

- Abajo loam, 0 to 10 percent slopes.
- Monticello very fine sandy loam, 0 to 10 percent slopes.
- Monticello-Hovenweep complex, 2 to 10 percent slopes.

These soils are suited to cultivation, although there are severe limitations imposed by climate. The amount of precipitation fluctuates widely, both from year to year and within the year. About one-fourth of the time, there is less than 12 inches of precipitation during the year. May and June—a critical period for wheat—are dry months.

If these soils are fallowed in summer, they are best used to grow winter wheat. When moisture is favorable, a small grain can be seeded in spring or in fall after a row crop has been grown. Beans should be grown no more than 50 percent of the time, nor more than 4 years in succession, because they do not return enough crop residues to the soil (fig. 4). Alfalfa or grass may be grown in rows for hay or seed.

Although these soils are naturally high in fertility, crop residues need to be worked into the soil. Lack of sufficient crop residues makes the soils more susceptible to erosion, causes the content of organic matter and nitrogen to be depleted, and reduces the rate at which water moves into the soil. During years when moisture is favorable, it is desirable to add nitrogen to the soil to increase the protein content of wheat.

CAPABILITY UNIT IIIc-2

The only soil in this capability unit—Northdale loam, 0 to 6 percent slopes—is moderately deep and well drained. It is moderately permeable and has a moderate available moisture-holding capacity. Runoff is slow to medium, depending on the intensity of the precipitation and on the amount of frost in the soil when the snow melts. The soil is easy to till, but a plowsole forms if it is cultivated when too wet. It is moderately susceptible to water and wind erosion. Slopes range from 0 to 6 percent, and in most places this soil is undulating to gently rolling.

This soil is suited to cultivation, although severe limitations are imposed by climate. The amount of precipitation fluctuates widely, however, both from year to year and within the year. About one-fourth of the time, there is less than 12 inches of precipitation during the year. May and June—a critical period for wheat—are dry months.

If this soil is fallowed in summer, it is best used to grow winter wheat. When moisture is available, a small grain can be seeded in spring or in fall after a row crop has been grown. Beans should be grown no more than 50 percent of the time, nor more than 4 years in succession, because

Figure 4.—**A field of Monticello very fine sandy loam, 0 to 10 percent slopes. In the foreground are pinto beans, and in the background, winter wheat.**

they do not return enough crop residues to the soil. Alfalfa or grass may be grown in rows for hay or seed.

If precipitation is unfavorable during the time when wheat is rotated with fallow, yields will probably be 15 to 25 percent lower than the yields on the soils in capability unit IIIc-1. This is because this soil stores less moisture during the period when it is fallow than is stored by the soils of capability unit IIIc-1.

This soil is high in natural fertility, but crop residues need to be worked into it. Lack of sufficient crop residues causes the soil to become more susceptible to erosion, causes the content of organic matter and nitrogen to be depleted, and reduces the rate at which water soaks in. During years when moisture is favorable, it is desirable to add nitrogen to the soil to increase the protein content of wheat.

CAPABILITY UNIT IIIc-3

The soils in this capability unit are deep and well drained or imperfectly drained. They are slowly or moderately permeable and are high in available moisture-holding capacity. The soils have formed in alluvial sediments and are medium textured to moderately fine textured. They are in swales and receive runoff water from adjacent steep areas. Runoff is slow to medium, depending on the amount of moisture received from adjacent higher lying areas. In many places the areas are dissected by the channels of intermittent streams. These channels have lowered the water table in the imperfectly drained soils of this capability unit so that they can be cultivated the same as the well-drained soils.

These soils are easy to till, but a plowsole forms if they are cultivated when too wet. Most of the time they cannot be tilled until later in spring than associated soils on the uplands, and crops cannot be harvested until later in fall. The soils in this unit are—

- Ackmen silt loam, 0 to 6 percent slopes.
- Pack silt loam, 2 to 6 percent slopes.
- Vega clay loam, 0 to 6 percent slopes.

These soils are suited to cultivation, although severe limitations are imposed by the climate and their location. The amount of precipitation fluctuates widely, both from year to year and within the year. About one-fourth of the time, there is less than 12 inches of precipitation during the year. May and June—a critical period for wheat—are dry months.

If these soils are fallowed in summer, they are best used to grow winter wheat. When moisture is favorable, a small grain can be seeded in spring or in fall after a row crop has been grown. Beans should be grown no more than 50 percent of the time, nor more than 4 years in succession, because they do not return enough crop residues to the soil. Alfalfa or grass can be grown in rows for hay or seed. The Pack soil is used mainly for pasture or irrigated meadow.

Although these soils are high in natural fertility and their content of organic matter ranges from 3 to 6 percent, crop residues need to be worked into the soil to maintain their fertility and good tilth. Grassed waterways are needed in the drainageways to control erosion and to dispose of excess water.

CAPABILITY UNIT IVe-1

The only soil in this capability unit—Northdale loam, 6 to 10 percent slopes—is moderately deep and is well

drained. It is moderate in permeability and has moderate available moisture-holding capacity. Natural fertility is moderately high. The soil occurs in areas where the terrain is undulating to rolling. It is moderately to highly susceptible to erosion. Runoff is medium to rapid, depending on the intensity of the precipitation and on the amount of frost in the soil when the snow melts.

This soil is about 6 inches shallower over bedrock than Northdale loam, 0 to 6 percent slopes. It is easy to till, but a plowsole forms if it is cultivated when too wet.

Because of severe limitations imposed by climate, moderate depth, and moderate slopes, this soil is not suited to continuous use for cultivated crops and is best used to grow grasses and legumes. The amount of precipitation fluctuates widely, both from year to year and within the year. About one-fourth of the time, there is less than 12 inches of precipitation during the year. The months of May and June are dry.

When prices for wheat are high and there is a period when precipitation is above normal, the soil is sometimes used to grow winter wheat. Then, it is necessary to use all of the management practices suggested in the section "Management of Dry Land" to protect the soil from erosion. If winter wheat is grown, the soil needs to be seeded to grasses or legumes one-third of the time. Because of its slope, this soil is not suited to beans. If it is retired from cultivation, it should be seeded to grasses or legumes.

CAPABILITY UNIT IVc-1

The soils in this capability unit are deep and moderately deep and are well drained. They have moderate to slow permeability, and the available moisture-holding capacity is moderate to high. The soils are medium textured to moderately fine textured. They are on alluvial fans and on undulating to rolling uplands. Runoff is slow to medium, depending on the intensity of the precipitation and on the amount of frost in the soil when the snow melts. These soils are moderately susceptible to water and wind erosion. They have a friable surface layer, are easy to till, and have high to moderately high inherent fertility. The soils in this unit are—

- Monticello very fine sandy loam, low rainfall, 2 to 10 percent slopes.
- Monticello-Hovenweep complex, low rainfall, 2 to 10 percent slopes.
- Scorup very fine sandy loam, 2 to 6 percent slopes.

Because of very severe limitations imposed by climate, these soils are not suited to continuous use for cultivated crops. The amount of precipitation fluctuates widely, both from year to year and within the year. About 40 percent of the time, there is less than 12 inches of precipitation during the year. The months of May and June are dry.

These soils are better suited to grasses and legumes than to cultivated crops (fig. 5). Nevertheless, when prices for wheat are favorable, and there is a period when the amount of precipitation is above normal, the soils are sometimes used to grow winter wheat. Then, it is necessary to use all of the management practices suggested in the section "Management of Dry Land" to protect the soils from erosion. If winter wheat is grown, the soils need to be seeded to grasses or legumes one-third of the time. Because of insufficient moisture, the soils are not suited to beans.

Figure 5.—**In foreground, good stand of crested wheatgrass on soils of capability unit IVc-1. Some areas of the soils in the background have been used for winter wheat, and others are being fallowed.**

CAPABILITY UNIT IVc-2

This capability unit consists of deep soils that are in swales where they receive water that flows from adjacent higher areas. The soils range from well drained to imperfectly drained, and the available moisture-holding capacity is high. Their surface layer is medium textured to moderately fine textured, and the underlying sediments are fine textured to medium textured. Natural fertility is high to moderately high.

In many places these soils are dissected by the channels of intermittent streams. These channels have lowered the water table in the imperfectly drained soils of this capability unit so that they can be managed the same as the well-drained soils.

Runoff ranges from slow to medium on these soils, depending on the amount of moisture received from adjacent areas. The soils are moderately to highly susceptible to erosion. The Shay and Ucolo soils are difficult to work. As a rule, they cannot be tilled so early in spring as the associated soils on uplands, nor can crops be harvested so early. The soils in this unit are—

- Ackmen loam, 0 to 6 percent slopes.
- Shay clay loam, 0 to 3 percent slopes.
- Ucolo silty clay loam, 0 to 3 percent slopes.

Because of very severe limitations imposed by climate and the risk of erosion, these soils are not suited to continuous use for cultivated crops. The amount of precipitation fluctuates widely, both from year to year and within the year. About 40 percent of the time, there is less than 12 inches of precipitation during the year. The months of May and June are dry. Crops grown on these soils may be damaged frequently by frost.

These soils are better suited to grasses and legumes than to cultivated crops. Nevertheless, when prices for wheat are favorable and there is a period when the amount of precipitation is above normal, the soils are sometimes used to grow winter wheat. Then, it is necessary to use all of the management practices suggested in the section "Management of Dry Land" to protect the soils from erosion. If winter wheat is grown, the soils need to be seeded to grasses or legumes one-third of the time. Because of insufficient moisture, the soils are not suited to beans. Grassed waterways are needed in the drainageways to control erosion and to dispose of excess water.

CAPABILITY UNIT IVc-3

The soils in this capability unit are moderately deep and well drained. They are on undulating to rolling uplands. Runoff is slow to medium, and permeability is moderate to slow. The natural fertility is high to moderately high, and the available moisture-holding capacity is moderate. These soils are moderately susceptible to water and wind erosion. The soils in this unit are—

Hovenweep loam, 2 to 6 percent slopes.
Northdale loam, low rainfall, 0 to 6 percent slopes.

Because of very severe limitations imposed by climate, these soils are not suited to continuous use for cultivated crops. The amount of precipitation fluctuates widely, both from year to year and within the year. About 40 percent of the time, there is less than 12 inches of precipitation during the year. The months of May and June are dry.

These soils are better suited to grasses and legumes than to cultivated crops. Nevertheless, when prices for wheat are favorable and there is a period when precipitation is above normal, they are sometimes used to grow winter wheat. Then, it is necessary to use all of the management practices suggested in the section "Management of Dry Land" to protect the soils from erosion. If winter wheat is grown, the soils need to be seeded to grasses or legumes one-third of the time. Because of insufficient moisture, these soils are not suited to beans.

CAPABILITY UNIT IVc-4

The soils in this capability unit—Lockerby and Hovenweep soils, 2 to 6 percent slopes—are moderately deep and are well drained or moderately well drained. They have slow to very slow permeability and are moderate in available moisture-holding capacity. Natural fertility is low to moderately high. The surface layer of these soils is medium textured to moderately fine textured. These soils are moderately susceptible to water and wind erosion. Runoff is slow to rapid, depending on the intensity of the precipitation and on the amount of frost in the soils when the snow melts. The Lockerby soils are rather difficult to till. A plowsole forms if they are tilled when too wet.

Because of very severe limitations imposed by climate and the characteristics of the soils, these soils are not suited to continuous use for cultivated crops. The amount of precipitation fluctuates widely, both from year to year and within the year. About 40 percent of the time, there is less than 12 inches of precipitation during the year. The months of May and June are dry. Crops grown on these soils are frequently damaged by frost.

These soils are better suited to grasses and legumes than to cultivated crops. Nevertheless, when prices for wheat are favorable and there is a period when the amount of precipitation is above normal, the soils are sometimes used to grow winter wheat. Then, it is necessary to use all of the management practices suggested in the section "Management of Dry Land" to protect the soils from erosion. If winter wheat is grown, the soils need to be seeded to grasses or legumes one-third of the time. Because of insufficient moisture and the likelihood of damage from frost, the soils are not suited to beans.

Crop Yields

Yields of pinto beans at Monticello, and of winter wheat at Monticello and Blanding, were studied in relation to effective rainfall for the 5-year period from 1949 through 1953. Climatic records for 40 years at Monticello, and for 50 years at Blanding, show that the greatest monthly precipitation occurs during August, September, and October; and the least, during May and June. The amount of precipitation fluctuates, however, both from month to month and from year to year. For example, the Monticello Weather Station has records showing annual precipitation as low as 6.56 inches and as high as 23.90 inches, with an average of 16.26 inches. The Blanding Weather Station has records showing annual precipitation as low as 5.31 inches and as high as 24.61 inches, with an average of 12.77 inches.

Summer storms of less than 0.50 inch furnish little moisture for crops and were not considered as effective rainfall. Some moisture is lost by surface runoff during intense storms, but no measurements have been made of the amount lost. The timing of storms greater than 0.50 inch affects yields greatly; therefore, the calculation of effective rainfall is only approximate. Timing of the storms was especially favorable for beans at Monticello in July and August of 1953.

According to the records kept at the Monticello Weather Station (see table 2), the annual precipitation at Monticello averages less than 12 inches during 9 years out of 40, or about 22 percent of the time. It averaged more than 15 inches, 20 years out of 40, or 50 percent of the time. According to records kept at Blanding, precipitation at that station was less than 12 inches, 20 years out of 50, or 40 percent of the time. It was more than 15 inches, 12 years out of 50, or 24 percent of the time.

Differences in evapotranspiration between the Monticello and Blanding areas would make a greater difference in the amount of effective moisture stored in the soils than these figures would indicate. This is because Monticello is at an elevation that is 1,000 feet higher than that at Blanding and has lower temperatures.

TABLE 2.—*Precipitation data for Monticello and Blanding, Utah*

Station	Length of record	Average annual precipitation	Wettest year [1]	Driest year [1]	Proportionate number of years: Less than 12 inches	Proportionate number of years: More than 15 inches
	Years	*Inches*	*Inches*	*Inches*	*Percent*	*Percent*
Monticello	40	16.26	23.90	6.56	22	50
Blanding	50	12.77	24.61	5.31	40	24

[1] The wettest years recorded at the Monticello and Blanding stations were 1911 and 1909, respectively. At both stations the driest year recorded was 1950.

In calculating the approximate amount of effective moisture for growing wheat in an alternate wheat-fallow cropping system, the following method is used: (1) The crop is grown using moisture that falls during a 2-year period, beginning with August and ending 2 years later in July. (2) Only storms of 0.50 inch or more during the growing season are considered to be effective. (3) One inch per storm is subtracted for the months of June, July, and August, and 0.50 inch per storm, for the months of April, May, September, and October, during the fallow period, because of losses by evaporation. As a rule, there are no more than two storms each month, and the surface soil dries to an estimated depth of 3 to 6 inches between storms. (4) Because the crop is planted near the end of September, after the soil has been left fallow for 1 year, the average potential evapotranspiration values from October through July are used to estimate moisture use during the crop year.

Table 3 gives estimated effective moisture at the Monticello and Blanding stations in relation to the production of dryland wheat on Monticello and Northdale soils. As shown in table 3, the first crop period studied, during which winter wheat was planted after a period of fallow, began in August 1947 and continued until the end of July 1949. During that time, according to the study made at Monticello, the amount of effective moisture stored in the soils was 18.46 inches. Of this, 10.18 inches was stored during the period of fallow before the crop was planted, and 8.28 inches was added during the time when the crop was growing. The crop on the Monticello soil yielded 20.0 bushels, and that on the Northdale soil yielded 21.5 bushels, or a weighted average of 20.6 bushels. Similarly, yields and amounts of effective moisture stored were recorded for this period at the Blanding station and, for other periods, at both stations.

Long-time weather records for the San Juan Area show extreme fluctuations in precipitation. These fluctuations are reflected in the period used for the analysis of crop yields. The data presented show higher effective moisture for crop production on the Monticello very fine sandy loams and on the Northdale loams than on the low rainfall phases of these soils.

The Monticello very fine sandy loams and Northdale loams occur in a zone of higher effective moisture than the low rainfall phases of these soils. They occur near Monticello and extend south and east of Monticello, including the several areas known locally as Dodge, Boulder, Horsehead, Cedar Point, and Bug Point. Old La Sal also receives more moisture than the areas near Blanding.

During periods of better moisture (August 1947 through July 1949), yields comparable to those obtained at Monticello were obtained at Blanding on soils of both the Monticello and Northdale series. When little moisture is received and stored in the soils, yields decrease. This is strongly reflected for the low rainfall phases of the moderately deep Northdale loams, and to some extent for the Northdale loams, when compared to the deep Monticello soils. This is because the Northdale soils are lower in moisture-holding capacity than the Monticello soils.

Table 3 shows that, during August 1950 through July 1952, good yields were obtained both on the Monticello and on the Northdale soils with a relatively low amount of moisture. These yields are attributed to the fact that several storms occurred in April and July of 1952 at a

TABLE 3.—*Estimated effective moisture as related to the production of dryland wheat for the soils of two series at Monticello and Blanding, Utah*

MONTICELLO

Crop period	Estimated effective moisture: Fallowed	Estimated effective moisture: Cropped	Estimated effective moisture: Total	Yields of wheat: Monticello very fine sandy loams	Yields of wheat: Northdale loams	Yields of wheat: Weighted average
	Inches	*Inches*	*Inches*	*Bushels*	*Bushels*	*Bushels*
August 1947 through July 1949	10.18	8.28	18.46	20.0	21.5	20.6
August 1948 through July 1950	11.20	6.55	17.67	19.2	15.0	18.1
August 1949 through July 1951	6.43	2.60	9.03	14.8	12.0	14.1
August 1950 through July 1952	3.97	7.06	11.03	20.3	19.8	20.1

BLANDING

Crop period	Estimated effective moisture: Fallowed	Estimated effective moisture: Cropped	Estimated effective moisture: Total	Yields of wheat: Monticello very fine sandy loams, low rainfall phases	Yields of wheat: Northdale loams, low rainfall phases	Yields of wheat: Weighted average
	Inches	*Inches*	*Inches*	*Bushels*	*Bushels*	*Bushels*
August 1947 through July 1949	8.62	6.46	15.08	18.3	20.0	18.9
August 1948 through July 1950	9.25	3.02	12.27	16.0	6.3	11.1
August 1949 through July 1951	3.87	1.40	4.27	15.8	1.7	9.7

time when wheat could make full use of the moisture. This emphasizes the importance of moisture coming at just the right time, even though a system of farming is being used in which crops are alternated with fallow.

During years when there is a good supply of moisture in the area represented by the Monticello Weather Station, yields of wheat on the deep Monticello soils and on the moderately deep Northdale soils are about the same. In less favorable years, yields on the Northdale soils are 15 to 25 percent lower than on the deep Monticello soils. In the area represented by the Blanding Weather Station, low yields are obtained on the low rainfall phases of the Northdale soils 40 percent or more of the time.

In calculating the approximate amount of effective moisture for bean production as an annual crop, the following method is used: (1) Only storms of 0.50 inch or more are considered to be effective. (2) Loss by evaporation of 1 inch per storm is subtracted for the month of June when the crop is starting, and of 0.50 inch per storm for the last half of September, October, April, and May before the crop is planted. As a rule, there are no more than two storms each month, and the surface soil dries to an estimated depth of 3 to 6 inches between storms. (3) For July, August, and the first half of September, when the soils are covered by the crop, average potential evapotranspiration values are used to estimate moisture use.

Table 4 gives estimated effective moisture at the Monticello station in relation to the production of dryland pinto beans on Monticello and Northdale soils. Because beans are not an important crop in the Blanding area, no estimates of effective moisture are given in table 4 for that

Table 4.—*Estimated effective moisture as related to the production of dryland pinto beans for the soils of two series at Monticello, Utah*

Crop period	Estimated effective moisture		Yields of pinto beans	
	Surplus or stored before plant growth	Evapotranspiration deficiency during plant growth	Monticello very fine sandy loams	Northdale loams
	Inches	*Inches*	*Pounds*	*Pounds*
September 15, 1948, through September 14, 1949.	10.63	9.00	628	575
September 15, 1949, through September 14, 1950.	6.91	11.09	547	350
September 15, 1950, through September 14, 1951.	3.53	7.74	126	47
September 15, 1951, through September 14, 1952.	9.11	8.52	672	583
September 15, 1952, through September 14, 1953.	6.12	5.82	770	433

area. It appears that at Blanding about 13 inches of precipitation would be needed annually for a crop of pinto beans to be successful. According to records kept at the Blanding Weather Station, however, less than 13 inches of precipitation annually is received 50 percent of the time. Only 30 percent of the time is there enough precipitation for a crop of beans to be reasonably safe. Therefore, the growing of beans in the area near Blanding would be hazardous.

In the more favorable moisture zone in which the Monticello Weather Station is located, it appears that 12 inches of annual precipitation is needed each year for a bean crop to be successful. According to records kept at the Monticello station, precipitation is below that amount 25 percent of the time, and in those years low yields can be expected or the crop will fail. About 50 percent of the time, the amount of precipitation is more than 15 inches, and reasonably good yields can be expected. In the remaining 25 percent of the time, the amount of precipitation ranges from 12 to 15 inches, or high enough for fair yields to be obtained.

The relationship between climate and the production of pinto beans is shown in table 4. Yields of about 628 to 770 pounds can be expected on the Monticello soils, and of about 433 to 583 pounds on the Northdale soils, in those years when the stored moisture exceeds the evapotranspiration figure. According to table 4, during the first crop period—September 15, 1948, through September 14, 1949—an estimated 10.63 inches of moisture was surplus, or was stored in the soil before the crop began to grow. During the same period, there was an evapotranspiration deficiency of 9.00 inches when the crop was growing. Yields for this period were good.

In the crop period extending from September 15, 1949, through September 14, 1950, yields were fairly good because some moisture had been carried over from the previous year and added to the supply received during the crop period. On the other hand, the crop period that extended from September 15, 1950, through September 14, 1951, was a year in which there was little precipitation. As a result, yields in that year were low. In the last crop period shown in the table—September 15, 1952, through September 14, 1953—yields were good because there were favorable storms in July and August.

On the basis of the limited recorded data and from observations made by technicians who have worked in the Area over a period of several years, other arable soils in the Area have been compared with those listed in tables 3 and 4, and estimates have been made of their suitability for growing wheat or beans. The following are results of these estimates:

Soils on which yields will be comparable to those on the Monticello very fine sandy loams are—

- Abajo loam, 0 to 10 percent slopes.
- Ackmen silt loam, 0 to 6 percent slopes.
- Monticello-Hovenweep complex, 2 to 10 percent slopes.
- Pack silt loam, 2 to 6 percent slopes.
- Vega clay loam, 0 to 6 percent slopes.

Soils on which yields will be comparable to those on the low rainfall phases of the Monticello very fine sandy loams are—

- Monticello-Hovenweep complex, low rainfall, 2 to 10 percent slopes.
- Scorup very fine sandy loam, 2 to 6 percent slopes.

Soils on which yields will be comparable to those on the low rainfall phases of the Northdale loams are—

- Ackmen loam, 0 to 6 percent slopes.
- Hovenweep loam, 2 to 6 percent slopes.
- Lockerby and Hovenweep soils, 2 to 6 percent slopes.
- Northdale loam, 6 to 10 percent slopes.
- Shay clay loam, 0 to 3 percent slopes.
- Ucolo silty clay loam, 0 to 3 percent slopes.

Range Management[2]

This section gives information about the current use of rangeland in the Area. It tells about how the soils in the Area are grouped in range sites and describes how these range sites are managed. Finally, it mentions some of the desirable practices that apply to most rangeland.

Current use of rangeland

The management of rangeland is of great importance in the San Juan Area. In about 66 percent of the Area, the soils are poor, the climate is not favorable for cultivated crops, or water is lacking for irrigation. This acreage can be used only for grazing or for growing trees. Good management must be used if profitable yields of forage are to be obtained. If the soils are managed properly, there will be enough forage on most of them so that the range can be grazed year after year and harvestable woodland products obtained.

Because so little of the land is suitable for cropping, grazing lands have always had a high value in the Area. The number of sheep and cattle in the Area reached its peak roughly between 1925 and 1930 and has declined since that time. Table 5 gives the number of cattle and sheep in San Juan County in stated years. The figures given were reported by the U.S. Bureau of the Census.

Table 5.—*Number of cattle and sheep*

Period	Cattle	Sheep
1910	20,316	92,507
1920	15,764	44,060
1925	26,184	109,482
1930	15,168	119,802
1950	18,776	67,690
1954	19,634	57,288

Heavy grazing by large numbers of livestock has brought changes to the vegetation in the Area and has caused the range to deteriorate. Some of the better grasses and forbs have been reduced, both in number and in vigor, or have been replaced by plants that have little or no value for grazing. On abandoned cropland and on excessively grazed areas, Russian-thistle, cheatgrass, and snakeweed have become the dominant plants and rabbitbrush grows in a few places.

New grasses, suitable for grazing, have been introduced on a large acreage of soils that were formerly dry-farmed. They have also been seeded on areas cleared of big sagebrush, black sagebrush, pinyon, and juniper. Heavily grazed woodlands, made up of pinyon and juniper, in many places now have only a sparse understory of forage plants. Consequently, pinyon and juniper increase more rapidly in these woodlands than in woodlands that have a thick understory.

Range condition and range sites

To plan the best use of his range, the range operator needs to know the kinds of range plants that are native to his area and the combinations in which they grow. He needs to be able to read the signs that show him whether his range is getting better or worse.

The basic unit on which management and treatment of the range is determined is the range site. A range site is an area of range uniform enough in climate, soil, and topography to produce a particular kind and amount of vegetation. This, in most instances, is the combination of plants that grew on the site before the range was affected by grazing or cultivation and is termed potential vegetation. Generally, the potential vegetation is the most productive combination of range plants that a site can produce.

The condition of the range is determined by comparing the kind and amount of present vegetation with the potential vegetation for that range site. It is related to the number of increasers, decreasers, and invaders on the site. Four condition classes have been defined. Range in excellent condition has from 76 to 100 percent of the vegetation characteristic of the potential vegetation that was on the site originally; one in good condition, 51 to 76 percent; one in fair condition, 26 to 51 percent; and one in poor condition, less than 26 percent.

Improving the native vegetation on the range will increase the amount of forage produced and will help to conserve soil and water. To improve the vegetation, the rancher needs to manage grazing so as to encourage the best native forage plants.

Livestock graze selectively and seek out the more palatable plants. If an area is grazed too severely, the more palatable species, called decreasers, will decrease. Their places will be taken by less palatable species (increasers) that were part of the original vegetation, or by other kinds of plants that were not part of the potential vegetation, called invaders, that can now find room to grow.

The amount of usable forage on the range sites in this Area varies from year to year, depending upon the weather. It depends particularly on the amount of precipitation that has been received. In years of drought, yields on all of the sites are drastically reduced.

Precipitation recorded by the U.S. Weather Bureau at Monticello and Blanding, shown in table 6, is representative of that for the Upland range sites, and precipitation at Monticello is representative of that for the Semiwet Meadow range site. Climatic data for the Semidesert range sites, south of Blanding, are estimated.

Annual yields of usable forage in the highest potential condition, on an air-dry basis, are shown for each range site for favorable and for less favorable years. Favorable years are those in which the precipitation is at or near the maximum and other growing conditions are favorable; in such years the yields of forage will be near the maximum possible for the site. Unfavorable years are those in which the precipitation is at or near the minimum and other growing conditions are unfavorable; in such years the yields of forage will be near the minimum for the site.

[2] This section was prepared in cooperation with Lamar R. Mason, range conservationist, and Waldo R. Frandsen, Washington Field range conservationist (West), Soil Conservation Service.

TABLE 6.—*Records of precipitation at Monticello and Blanding, Utah*

Station	Length of record	Average annual precipitation	Wettest year [1]	Driest year [1]	Proportion of precipitation received in each 3-month period: Jan., Feb., Mar.	Apr., May, June	July, Aug., Sept.	Oct., Nov., Dec.
	Years	*Inches*	*Inches*	*Inches*	*Percent*	*Percent*	*Percent*	*Percent*
Monticello	40	16.26	23.90	6.56	27	16	31	26
Blanding	50	12.77	24.61	5.31	28	14	28	30

[1] The wettest years recorded at the Monticello and Blanding stations were 1911 and 1909, respectively. At both stations the driest year recorded was 1950.

After stockmen have compared their current yields of forage with the highest yields given for the particular range site, they will have an incentive to improve their range management practices. By adjusting the use of the range, they can improve its condition. In time, much higher yields will be obtained.

The scientific names of plants that grow on ranges in the San Juan Area are given in the following list. Wherever the standardized plant name differs from the name commonly used, the standardized name is given in parentheses.

GRASSES AND GRASSLIKE PLANTS

Scientific name	*Common name*
Agropyron dasystachyum	Thickspike wheatgrass.
A. smithii	Western wheatgrass (bluestem wheatgrass).
Agrostis alba	Redtop.
Aristida spp	Three-awn.
Bouteloua curtipendula	Side-oats grama.
B. gracilis	Blue grama.
Bromus tectorum	Cheatgrass (cheatgrass brome).
Carex spp	Dryland sedge (sedge).
Deschampsia caespitosa	Tufted hairgrass.
Elymus cinereus	Giant wildrye (Great Basin wildrye).
E. glaucus	Blue wildrye.
E. simplex	Bullgrass (low creeping wildrye).
E. triticoides	Beardless wildrye (creeping wildrye).
Hilaria jamesii	Galleta.
Hordeum jubatum	Foxtail (foxtail barley).
Juncus balticus	Baltic rush.
Koeleria cristata	Junegrass (prairie junegrass).
Oryzopsis hymenoides	Indian ricegrass.
Phleum pratense	Timothy.
Poa spp	Bluegrass.
P. pratensis	Kentucky bluegrass.
Sitanion hystrix	Squirreltail (bottlebrush squirreltail).
Sporobolus cryptandrus	Sand dropseed.
Stipa comata	Needle-and-thread.

BROAD-LEAVED HERBS OR WEEDS

Scientific name	*Common name*
Achillea lanulosa	Yarrow (western yarrow).
Aconitum spp	Monkshood.
Artemisia dracunculoides	Herbaceous sage (falsetarragon sagebrush).
A. gnaphalodes	Herbaceous sage (cudweed sagebrush).
Aster spp	Aster.
Astragalus spp	Astragalus (loco; milkvetch; poisonvetch).
Balsamorhiza sagittata	Balsamroot (arrowleaf balsamroot).
Castilleja spp	Indian paintbrush (painted-cup).
Crepis acuminata	Hawksbeard (tapertip hawksbeard).
Dodecatheon pauciflorum	Shootingstar (darkthroat shootingstar).
Erigeron spp	Daisy (fleabane).
Eriogonum spp	Buckwheat (Eriogonum).
Geranium spp	Geranium.
Grindelia squarrosa	Gumweed (curlycup gumweed).
Helianthella uniflora	Manyflower sunflower (oneflower helianthella).
Heracleum lanatum	Cowparsnip.
Iva axillaris	Povertyweed (poverty sumpweed).
Lathyrus supp	Peavine.
Lupinus spp	Lupine.
Pedicularis groenlandica	Elephanthead.
Penstemon spp	Penstemon.
Phlox longifolia	Phlox (longleaf phlox).
P. stansburyi	Phlox (Stansbury phlox).
Potentilla spp	Cinquefoil.
Salsola kali var. *tenuifolia*	Russian-thistle (tumbling Russian-thistle).
Solidago spp	Goldenrod.
Sphaeralcea coccinea	Globemallow (scarlet globemallow).
Taraxacum officinale	Dandelion.
Trifolium spp	Clover.
Triglochin maritima	Arrowweed (shore podgrass).
Zigadenus spp	Deathcamas.

SHRUBS AND TREES

Scientific name	*Common name*
Amelanchier alnifolia	Serviceberry (Saskatoon serviceberry).
Artemisia frigida	Fringed sagewort (fringed sagebrush).
A. nova	Black sagebrush.
A. tridentata	Big sagebrush.
Atriplex canescens	Fourwing saltbush.
Cercocarpus betuloides	Birchleaf mahogany.
C. ledifolius	Mahogany (curlleaf mountain-mahogany).
Chrysothamnus nauseosus	Rubber rabbitbrush (big rabbitbrush).
C. stenophyllus	Little rabbitbrush (small rabbitbrush: yellow rabbitbrush).
C. viscidiflorus var. *pumilus*	Low rabbitbrush (Low Douglas rabbitbrush).
Cowania stansburiana	Cliffrose (Stansbury cliffrose).
Ephedra spp	Ephedra (jointfir; Mormon tea; Brigham tea).
Eurotia lanata	Winterfat (common winterfat).
Gutierrezia sarothrae	Snakeweed (broom snakeweed).
Juniperus osteosperma	Juniper (Utah juniper).
J. scopulorum	Rocky Mountain redcedar (Rocky Mountain juniper).
Opuntia spp	Cactus (pricklypear).
Peraphyllum ramosissimum	Squaw-apple.
Pinus edulis	Pinyon pine.
P. monophylla	Singleleaf pinyon pine.
Purshia tridentata	Bitterbrush (antelope bitterbrush).
Quercus gambelii	Oakbrush (Gambel oak).
Sarcobatus vermiculatus	Greasewood (black greasewood).
Symphoricarpos oreophilus	Snowberry (mountain snowberry).
S. rotundifolius	Snowberry (roundleaf snowberry).
S. utahensis	Snowberry (Utah snowberry).
Tetradymia canescens var. *inermis*	Horsebrush (spineless horsebrush).
T. spinosa	Spiny horsebrush (cottonthorn horsebrush).

Descriptions of range sites

The soils of the San Juan Area have been grouped in the range sites described in the following pages. The description of each range site gives the important characteristics of the soils.

The soils of five series are in the Upland Loam range site if there are no trees on them, and in the Upland Loam (Pinyon-Juniper) range site if there are trees. For the same reason, the Lockerby soil and the soils of the Lockerby and Hovenweep complexes are in two range sites—Upland Clay and Upland Clay (Pinyon-Juniper). No measurable differences in these soils are associated consistently with the differences in site. If there has been a change in vegetation, it took place so recently that there has been no change in the soils.

The potential vegetation on most areas of these soils was probably an open stand of pinyon and juniper and an understory of grasses and forbs. Disturbance by fire or by other agencies before these soils were used by white settlers may have changed the rather delicate balance in some places so that the pinyon and juniper were destroyed and the cover became predominantly grass. Such areas are now represented by the Upland Loam or Upland Clay range sites. The content of organic carbon in the Monticello soils on the Upland Loam range site and on the Upland Loam (Pinyon-Juniper) range site is nearly identical to a depth of 60 inches. Apparently, the competition from trees has not caused a decrease in the content of organic carbon in the soils of the Upland Loam range site. If trees had been the dominant potential vegetation, there would have been less organic carbon to a depth of 60 inches.

Many of the range sites have value both as range and as woodland. The trees growing on them are chiefly pinyon and juniper, but ponderosa pines grow in a few small, scattered areas. Although the wooded areas are used for grazing, the landowner can also improve them so that they will yield more wood products. Good management practices, such as the cutting of mature, misshapen, and diseased trees, will permit younger, more vigorous trees to grow. Some pruning and thinning of trees is also desirable.

The groves of ponderosa pine within the survey area are scattered and are so located that they are of little value as sawtimber. In accessible areas where juniper is predominant, the condition of the present stand indicates that the areas were cut over intensively in the past and the trees used as fenceposts. As a result, the stands of juniper have deteriorated to the point where they have little economic value. Nevertheless, juniper, grown for fenceposts, has a high potential value in the Area.

Pinyon pines have value as a source of nuts, for use as fuel, and for sale as Christmas trees. Good markets nearby are not available, however, and the wood sold for fuel does not bring a favorable price. The growing of pinyon pines for Christmas trees, however, may become desirable on selected sites.

Good management practices need to be applied to the areas that are used both for grazing and for woodland products. Good management will allow the rancher to obtain the maximum production of both forage and woodland products (fig. 6).

SEMIWET MEADOW

The soils of this range site are deep, medium textured or moderately fine textured, and dark colored. They are in narrow, slightly to moderately depressed stream bottoms and in drainageways, where they receive water from the adjacent uplands. The areas are on the floors of valleys near the east end of Old La Sal and are at elevations ranging from 5,800 to 7,500 feet. Slopes range from 0 to 3 percent.

Throughout the major part of the year, the soils are influenced by a fluctuating high water table. Their available moisture-holding capacity is high. The following soils are in this range site:

- Ackmen silt loam, moderately deep water table, 0 to 3 percent slopes.
- Pack silt loam, moderately deep water table, 0 to 3 percent slopes.
- Vega clay loam, moderately deep water table, 0 to 3 percent slopes.

On this range site the yields of forage plants and the kinds of plants are affected more by the amount of runoff received from adjoining areas and by the height of the water table than by precipitation. The amount of precipitation varies greatly from year to year. In most years moisture is deficient late in the growing season.

About 55 percent of the precipitation occurs during the period when plants are growing (April 10 to October 15), and about 45 percent, during the period when the plants are dormant. Except for May and June, which are drier than the other months of the year, the monthly precipitation is fairly uniform. The temperatures and precipitation recorded at the Monticello Weather Station are representative for this range site.

For forage plants on this range site, the growing season usually begins between April 1 and April 10 and ends between October 15 and October 31. The average frost-free period is 143 days, or May 15 to October 5. Ordinarily, the plants begin to dry up late in July, but, if temperatures are favorable and there is more than the usual amount of moisture, they remain green until frost. In years when precipitation is above average, the water table remains high during the entire growing season. During those years, rushes, broadleaf sedge, and other plants that grow in wet areas are likely to increase. Some of these plants are not desirable and cause the quality of the forage to decline. They do not affect the total yield materially.

The estimated density of the forage plants on this range site ranges from 65 to 75 percent. From 40 to 50 percent of the potential vegetation consists of tufted hairgrass, blue wildrye, redtop, and other decreaser grasses. Western wheatgrass, beardless wildrye, sedge, baltic rush, and other increaser grasses make up 30 to 40 percent of the cover. Clover, arrowweed, aster, cinquefoil, monkshood, elephanthead, shootingstar, goldenrod, cowparsnip, and other forbs make up 5 to 10 percent. In places the vegetation includes willow and shrubby cinquefoil, but these plants are very minor. Common invaders are rubber rabbitbrush, dandelion, gumweed, povertyweed, foxtail, and other annual weeds.

When the range is in its highest potential condition, annual yields of usable forage range from 1,800 pounds per acre, air dry, in a favorable year to 900 in an unfavorable year.

Figure 6.—This Upland Clay (Pinyon-Juniper) range site is valuable both for grazing and for woodland products.

UPLAND LOAM

The soils of this range site are deep or moderately deep, medium textured or moderately fine textured, and well drained. In some of the areas, there are cobblestones in the surface layer. The soils are on gently sloping to rolling uplands, in narrow, gently sloping drainageways, and on flood plains. Some areas used for range are on Dodge Point and Summit Point, next to dry-farmed fields. The soils are at elevations ranging from 5,800 to 7,500 feet and have slopes of 0 to 25 percent.

The weak crust on the surface of these soils restricts the infiltration of moisture to some extent. The soils are moderate to high in available moisture-holding capacity, the internal movement of water is not restricted, and roots can penetrate easily. The soils are likely to erode if an adequate cover of plants is not maintained. The following soils are in this range site:

Abajo loam, 0 to 10 percent slopes.
Abajo cobbly loam, 2 to 25 percent slopes.
Abajo cobbly clay loam, 10 to 25 percent slopes.
Ackmen loam, 0 to 6 percent slopes.
Ackmen silt loam, 0 to 6 percent slopes, moderately eroded.
Ackmen loam, 0 to 10 percent slopes, moderately eroded.
Ackmen loam, 0 to 10 percent slopes, severely eroded.
Ackmen silt loam, 0 to 6 percent slopes.
Ackmen silt loam, 0 to 6 percent slopes, moderately eroded.
Ackmen silt loam, 0 to 6 percent slopes, severely eroded.
Ackmen silty clay loam, moderately deep over gravel, 2 to 25 percent slopes.
Hovenweep loam, 2 to 6 percent slopes.
Monticello very fine sandy loam, 0 to 10 percent slopes.
Monticello very fine sandy loam, low rainfall, 2 to 10 percent slopes.
Monticello-Hovenweep complex, 2 to 10 percent slopes.
Monticello-Hovenweep complex, low rainfall, 2 to 10 percent slopes.
Northdale loam, 0 to 6 percent slopes.
Northdale loam, low rainfall, 0 to 6 percent slopes.
Northdale loam, 6 to 10 percent slopes.
Northdale loam, 2 to 10 percent slopes, severely eroded.
Northdale loam, low rainfall, 6 to 10 percent slopes.
Pack silt loam, 2 to 6 percent slopes.
Pack cobbly silt loam and silt loam, 2 to 6 percent slopes.
Scorup very fine sandy loam, 2 to 6 percent slopes.
Scorup cobbly very fine sandy loam, 2 to 25 percent slopes.
Vega clay loam, 0 to 3 percent slopes, severely eroded.
Vega clay loam, 0 to 6 percent slopes.
Vega clay loam, 0 to 6 percent slopes, moderately eroded.

The Abajo, Hovenweep, Monticello, Northdale, and Scorup soils are in this range site if no trees, or only a few trees, are growing on them. They are in the Upland Loam (Pinyon-Juniper) range site if a number of trees are growing on them.

On this range site the amount of precipitation varies greatly from year to year. About 55 percent of it falls during the period when forage plants are growing (April 10 to October 15), and about 45 percent, during the period when the plants are dormant. Except for May and June, which are drier than the other months of the year, monthly precipitation is fairly uniform. The temperatures and precipitation at Monticello are representative for this range site.

For forage plants on this range site, the growing season usually begins between April 1 and April 10 and ends between October 15 and October 31. The average frost-free period is 143 days, or May 15 to October 5. If temperatures are favorable and there is more than the usual amount of moisture, plants remain green until frost.

This range site is separated from the Upland Loam (Pinyon-Juniper) range site because the vegetation is predominantly grass and there are only a few pinyon pines and junipers. The original vegetation may have included more pinyon and juniper. The estimated density of the forage plants on this site ranges from 40 to 50 percent. From 30 to 40 percent of the original vegetation consisted of decreaser grasses, such as native bluegrass, junegrass, and Indian ricegrass. Western wheatgrass, squirreltail, needle-and-thread, thickspike wheatgrass, beardless wildrye, galleta, sand dropseed, Kentucky bluegrass, blue grama, and other increaser grasses make up 40 to 50 percent of the cover.

About 5 to 10 percent of the cover is penstemon, astragalus, lupine, buckwheat, yarrow, hawksbeard, Indian paintbrush, balsamroot, and other forbs. Big sagebrush, bitterbrush, squaw-apple, serviceberry, winterfat, oakbrush, and other shrubs account for 5 to 10 percent. Common invaders are rubber rabbitbrush, little rabbitbrush, horsebrush, snakeweed, Russian-thistle, cheatgrass, and annual weeds.

When the range is in its highest potential condition, annual yields of usable forage range from 1,000 pounds per acre, air dry, in a favorable year to 650 in a less favorable year.

UPLAND LOAM (PINYON-JUNIPER)

The soils of this range site are deep or moderately deep, medium textured or moderately fine textured, and well drained. In some of the areas, the surface layer contains cobblestones. The soils are on gently sloping to rolling uplands at elevations ranging from 5,800 to 7,100 feet. They have slopes of 0 to 25 percent. One of the areas is on Cedar Point (sec. 29, T. 35 S., R. 26 W.).

Areas of these soils between the trees have a weak crust on the surface. This crust tends to keep moisture from infiltrating into the soil. The soils have good available moisture-holding capacity. Water moves through the profile readily, and roots can penetrate easily. The soils are susceptible to erosion if an adequate cover of plants is not maintained. The following soils are in this range site:

Abajo loam, 0 to 10 percent slopes.
Abajo cobbly loam, 2 to 25 percent slopes.
Abajo cobbly clay loam, 10 to 25 percent slopes.
Hovenweep loam, 2 to 6 percent slopes.
Monticello very fine sandy loam, 0 to 10 percent slopes.
Monticello very fine sandy loam, low rainfall, 2 to 10 percent slopes.
Monticello-Hovenweep complex, 2 to 10 percent slopes.
Monticello-Hovenweep complex, low rainfall, 2 to 10 percent slopes.
Northdale loam, 0 to 6 percent slopes.
Northdale loam, low rainfall, 0 to 6 percent slopes.
Northdale loam, 6 to 10 percent slopes.
Northdale loam, low rainfall, 6 to 10 percent slopes.
Scorup very fine sandy loam, 2 to 6 percent slopes.
Scorup cobbly very fine sandy loam, 2 to 25 percent slopes.

In the area where this range site is located, the amount of precipitation varies greatly from year to year. About 55 percent of the precipitation falls during the period when forage plants are growing (April 10 to October 15), and about 45 percent, during the period when the plants are dormant. Except for May and June, which are drier than the other months of the year, monthly precipitation is fairly uniform. For this range site, the temperatures and precipitation at Blanding and Monticello are representative.

The growing season for forage plants on this range site generally begins between April 1 and April 10 and ends between October 15 and October 31. The average frost-free period is 143 days, or May 15 to October 15. Except in years that are drier than average, plants remain green until frost.

This range site is similar to the Upland Loam range site, except for its open to fairly dense stand of pinyon and juniper. The understory on both of these range sites is made up of the same kinds of plants, but on the Upland Loam (Pinyon-Juniper) range site the yield of forage is only about half that of the Upland Loam range site and the density of growth is somewhat less than half. The estimated density of the forage plants on the Upland Loam (Pinyon-Juniper) range site is 15 to 20 percent.

When the range is in its highest potential condition, the annual yields of usable forage range from 500 pounds per acre, air dry, in a favorable year to 325 pounds in a less favorable year. The stand of pinyon and juniper produces a good volume of high-quality posts and Christmas trees. If a market were available, growing and selling these woodland products would be a fairly profitable enterprise.

UPLAND CLAY

The soils of this range site are moderately deep or deep, moderately well drained or imperfectly drained, and fine textured or moderately fine textured. They have formed in materials weathered from shale. The soils are on smooth to gently rolling uplands, on gently sloping flood plains, and in swales. A specific location is NE¼ sec. 6, T. 33 S., R. 25 E. The elevation ranges from 6,500 to 7,100 feet, and slopes range from 0 to 10 percent.

The soils have a surface layer that crusts over and puddles easily; consequently, moisture cannot penetrate readily. The fine texture of the soils restricts the movement of water through the profile. Roots can penetrate when the soils are moist, but they cannot penetrate the shale, which is at a moderate depth in some of the soils. The soils have good available moisture-holding capacity. They are susceptible to erosion if an adequate cover of plants is not maintained. The following soils are in this range site:

Lockerby silty clay loam, 2 to 6 percent slopes, moderately eroded.
Lockerby and Hovenweep soils, 2 to 6 percent slopes.
Lockerby and Hovenweep soils, 6 to 10 percent slopes.
Lockerby and Menefee soils, 2 to 10 percent slopes.
Shay clay loam, 0 to 3 percent slopes.
Shay clay loam, 0 to 3 percent slopes, severely eroded.

Ucolo silty clay loam, 0 to 3 percent slopes.
Ucolo silty clay loam, 2 to 10 percent slopes, moderately eroded.
Ucolo silty clay loam, 0 to 3 percent slopes, severely eroded.

Areas of Lockerby, Hovenweep, and Menefee soils that *have no trees growing on them are in this range site.* The areas of these soils where trees are growing are in the Upland Clay (Pinyon-Juniper) range site.

In the areas where this range site is located, the amount of precipitation varies greatly from year to year. About 55 percent of the precipitation falls during the period when forage plants are growing (April 10 to October 15), and about 45 percent, during the period when the plants are dormant. Except for May and June, which are drier than the other months of the year, monthly precipitation is fairly uniform. The temperatures and precipitation at Blanding and Monticello are representative for this range site.

For forage plants on this range site, the growing season generally begins between April 1 and April 10 and ends between October 15 and October 31. The frost-free period is 143 days, or May 15 to October 5. Except during years that are drier than average, plants remain green until frost.

Originally, the vegetation on this range site may have been pinyon and juniper. Now, the potential vegetation is primarily grass, but there are a few shrubs and an occasional pinyon pine or juniper. The range site is described separately from the Upland Clay (Pinyon-Juniper) range site because little pinyon and juniper now grow on it and the forage plants consist mostly of grass.

The estimated density of the forage plants on this range site ranges from 35 to 45 percent. From 25 to 35 percent of the potential vegetation consists of junegrass, native bluegrass, Indian ricegrass, and other decreaser grasses. Western wheatgrass, thickspike wheatgrass, beardless wildrye, squirreltail, needle-and-thread, galleta, blue grama, Kentucky bluegrass, and other increaser grasses make up 45 to 55 percent of the cover. An additional 5 percent consists of Indian paintbrush, manyflower sunflower, penstemon, astragalus, lupine, herbaceous sage, and other broad-leaved herbs. Common invaders are gumweed, annual weeds, rubber rabbitbrush, little rabbitbrush, cheatgrass, Russian-thistle, and horsebrush. Shrubs, such as black sagebrush, fringed sagewort (fringed sagebrush), bitterbrush, squaw-apple, winterfat, fourwing saltbush, and birchleaf mahogany, make up 15 to 20 percent. There are a few scattered pinyon pines and junipers.

When the range is in its highest potential condition, annual yields of usable forage range from 800 pounds per acre, air dry, in a favorable year to 500 pounds in a less favorable year.

UPLAND CLAY (PINYON-JUNIPER)

The soils of this range site are moderately deep, well drained or moderately well drained, and fine textured or moderately fine textured. They have been strongly influenced by shale. The soils are on smooth to gently rolling uplands, about 7 miles directly east of Monticello, and are at elevations ranging from 6,500 to 7,100 feet. Slopes are 2 to 10 percent.

In areas of these soils between the trees, the surface layer crusts over easily. As a result, the movement of moisture into the soils is restricted. The movement of water through the profile is also restricted as the result of the fine texture of the soils. Roots cannot penetrate deeply in areas where shale is at a moderate depth.

These soils have moderate available moisture-holding capacity. They are susceptible to erosion if an adequate cover of plants is not maintained. The following soils are in this range site:

Lockerby silty clay loam, 2 to 6 percent slopes, moderately eroded.
Lockerby and Hovenweep soils, 2 to 6 percent slopes.
Lockerby and Hovenweep soils, 6 to 10 percent slopes.
Lockerby and Menefee soils, 2 to 10 percent slopes.

In the areas where this range site is located, the amount of precipitation varies greatly from year to year. About 55 percent of the precipitation falls during the period when forage plants are growing (April 10 to October 15), and about 45 percent, during the period when the plants are dormant. Except for May and June, which are drier than the other months of the year, the monthly precipitation is fairly uniform. The temperatures and precipitation at Blanding and Monticello are representative for this range site.

For forage plants on this range site, the growing season generally begins between April 1 and April 10 and ends between October 15 and October 31. The frost-free period is 143 days, or May 15 to October 5. Except during years that are drier than average, plants remain green until frost.

Except for the open to fairly dense stand of pinyon and juniper, the vegetation on this range site is very similar to that on the Upland Clay range site. Both sites support the same kinds of plants, but the yield of forage on the Upland Clay (Pinyon-Juniper) range site is only about half that on the Upland Clay range site, and its density is slightly less than half. The estimated density of the forage plants on this range site ranges from 10 to 15 percent.

Where this range site is in its highest potential condition, the annual yields of usable forage range from 400 pounds per acre, air dry, in a favorable year to 250 in a less favorable year. The stand of pinyon and juniper produces a good volume of high-quality posts and Christmas trees. If a market were available, the growing of these woodland products could be fairly profitable.

UPLAND SHALE (PINYON-JUNIPER)

The soils of this range site are shallow or very shallow and are moderately fine textured. They overlie rather hard, fractured shale. The parent material was mainly shale, but the surface layer also contains reddish-brown eolian sediments. The soils are on gently to moderately sloping upland ridges and hills. One area is 12½ miles east of the Monticello School. The soils are at elevations ranging from 6,500 to 7,100 feet and have slopes of 2 to 40 percent.

In areas of these soils that are bare, the surface layer crusts over easily. This reduces the rate at which moisture infiltrates. Roots cannot penetrate the underlying shale.

The soils are low in available moisture-holding capacity. They are susceptible to erosion if an adequate cover of plants is not maintained. The following soils are in this range site:

Menefee clay loam, 2 to 25 percent slopes.
Menefee shaly clay loam, 2 to 25 percent slopes.
Menefee cobbly clay loam, 4 to 40 percent.

In the areas where this range site is located, the amount of precipitation varies greatly from year to year. About 55 percent of the precipitation falls during the period when forage plants are growing (April 10 to October 15), and about 45 percent, during the period when the plants are dormant. Except for May and June, which are drier than the other months of the year, the monthly precipitation is fairly uniform. The temperatures and precipitation at Blanding and Monticello are representative for this range site.

For forage plants on this site, the growing season usually begins between April 1 and April 10 and ends between October 15 and October 31. The frost-free perod is 143 days, or May 15 to October 5. Except during years that are drier than average, plants remain green until frost.

The potential vegetation on this range site is typically an open overstory of pinyon and juniper with an understory of shrubs and grasses. The number of shrubs is proportionately greater on this range site than on other sites, such as the Upland Loam (Pinyon-Juniper) or Upland Clay (Pinyon-Juniper).

The estimated density of the forage plants on this range site ranges from 5 to 15 percent. From 25 to 35 percent of the potential vegetation consists of tall native bluegrass, needle-and-thread, western wheatgrass, Indian ricegrass, and other decreaser grasses. Increaser grasses, such as galleta, blue grama, dryland sedge, Kentucky bluegrass, and squirreltail, make up 15 to 25 percent of the cover. Globemallow, herbaceous sage, aster, daisy, yarrow, peavine, geranium, astragalus, and other broad-leaved herbs comprise 10 to 20 percent.

Black sagebrush, fourwing saltbush, squaw-apple, oakbrush, serviceberry, snowberry, mahogany, bitterbrush, winterfat, and other shrubs make up 25 to 40 percent of the vegetation. There are a few young pinyon pines and junipers. Common invaders are Russian-thistle, cheatgrass, horsebrush, gumweed, big rabbitbrush, snakeweed, little rabbitbrush, and cactus.

When the range is in its highest potential condition, annual yields of usable forage range from 175 pounds per acre, air dry, in a favorable year, to 75 pounds in a less favorable year. The woodland products from the stand of pinyon and juniper are not of the quality of those from the Upland Clay (Pinyon-Juniper) or the Upland Loam (Pinyon-Juniper) range sites. The trees on this range site, however, are capable of producing a fairly large volume and good quality of posts. A few of the pinyon pines are also used for Christmas trees.

UPLAND STONY HILLS (PINYON-JUNIPER)

The soils of this range site are droughty, shallow or very shallow, and very stony. They are medium textured and well drained. The soils overlie sandstone and shale. Many angular fragments of flagstone are on the surface, and in many places the bedrock outcrops.

These soils are in areas of broken topography at elevations of 5,800 to 7,100 feet and have slopes of 2 to 70 percent. Some areas are next to and within the breaks or steep areas of Recapture Canyon, Devil Canyon, and Coal Bed Canyon, where little or no eolian material has been deposited. Steep and nearly vertical ledges of sandstone make up about 35 percent of this acreage, and there are a few escarpments of bedrock. The ledgy areas are in deep canyons, such as Montezuma, Coal Bed, Recapture, Westwater, Horsehead, and Monument. The steep and ledgy areas are included in this range site because they are intermingled with areas of better soils. The following soils are in this range site:

Montvale very rocky very fine sandy loam, 2 to 25 percent slopes.
Sandstone rockland, sloping.
Sandstone rockland, steep.

In the areas where this range site is located, the amount of precipitation varies greatly from year to year. About 55 percent of the precipitation falls during the period when forage plants are growing (April 10 to October 15), and about 45 percent, during the period when the plants are dormant. Except for May and June, which are drier than the other months of the year, the monthly precipitation is fairly uniform. The temperatures and precipitation at Blanding and Monticello are representative for this range site.

For forage plants on this range site, the growing season usually begins between April 1 and April 10 and ends between October 15 and October 31. The frost-free period is 143 days, or May 15 to October 5. Except during years that are drier than average, plants remain green until frost.

The estimated density of the forage plants on this range site ranges from 10 to 15 percent. The vegetative cover is chiefly an open stand of pinyon and juniper (fig. 7), but there are a few open stands of ponderosa pine. Shrubs are slightly more numerous on the north- and east-facing slopes than on slopes that face south or west. A few fairly large areas lack an overstory of pinyon and juniper. The understory is generally a mixture of grasses and shrubs. It includes Indian ricegrass, needle-and-thread, side-oats grama, tall native bluegrass, junegrass, and other decreaser grasses, which make up 30 to 40 percent of the potential vegetation.

Bullgrass, squirreltail, dryland sedge, Kentucky bluegrass, western wheatgrass, galleta, blue grama, sand dropseed, and other increaser grasses comprise 20 to 30 percent of the potential vegetation. Forbs, such as herbaceous

Figure 7.—**Pinyon, juniper, and big sagebrush are the predominant vegetation on this Upland Stony Hills (Pinyon-Juniper) range site.**

sage, yarrow, geranium, astragalus, aster, daisy, and hawksbeard, make up 5 to 10 percent. Big sagebrush, black sagebrush, bitterbrush, cliffrose, squaw-apple, birchleaf mahogany, serviceberry, snowberry, oakbrush, and other shrubs, as well as young junipers and pinyon pines, make up 20 to 35 percent of the cover. Common invaders are snakeweed, Russian-thistle, cheatgrass, annual weeds, rubber rabbitbrush, little rabbitbrush, horsebrush, and cactus.

When the range is in its highest potential condition, annual yields of usable forage range from 300 pounds per acre, air dry, in a favorable year to 150 in a less favorable year.

The stand of pinyon and juniper produces some posts and Christmas trees. Because of the rough topography, however, the areas where these trees grow are generally inaccessible and, therefore, the products have no great value. In a few areas, scattered ponderosa pines supply a small amount of sawtimber.

SEMIDESERT LOAM

This range site is made up of only one soil—Blanding very fine sandy loam, 2 to 10 percent slopes. This is a reddish-brown, deep soil that is well drained and medium textured. The soil has formed in eolian materials. It is on gently undulating to rolling uplands. One location is 6¼ miles south of Blanding, on both sides of State Highway 47. Elevations range from 5,500 to 6,000 feet, and slopes, from 2 to 10 percent.

This soil contains little organic matter. It has a weak crust on the surface that slows infiltration of water. The soil is high in available moisture-holding capacity. Water moves through the profile readily, and roots can penetrate easily. The soil is susceptible to erosion if an adequate cover of plants is not maintained.

In the areas where this range site occurs, the amount of precipitation averages between 8 and 12 inches annually. There is less total precipitation than at Blanding, but the pattern of distribution is similar. About 57 percent of the precipitation falls during the period when forage plants are growing (April 1 to October 30), and about 43 percent, during the period when the plants are dormant. Except for May and June, which are drier than the other months of the year, the monthly precipitation is fairly uniform.

For forage plants that grow in cool seasons on this range site, the growing season begins about March 15. The seed of these plants generally matures between July 1 and July 15. Usually, there is enough precipitation in summer and fall for these plants to become green again. Plants that grow in warm seasons, such as galleta and blue grama, generally start their growth between May 1 and May 15. Their seed matures between August 1 and August 15. The average frost-free period is 150 days.

The estimated density of the forage plants on this range site ranges from 25 to 30 percent. The potential vegetation consists mainly of a mixture of grasses and browse plants, but there are a few perennial forbs. From 50 to 60 percent of the potential vegetation consists of decreaser grasses, such as western wheatgrass, Indian ricegrass, needle-and-thread, and squirreltail. Galleta and blue grama are increaser grasses that make up 15 to 20 percent of the potential vegetation. Astragalus, buckwheat, phlox, globemallow, and other forbs make up no more than 5 percent, and winterfat, fourwing saltbush and other decreaser browse plants make up about 25 percent. From 5 to 10 percent consists of big sagebrush, ephedra, squaw-apple, and other shrubs. Common invaders are Russian-thistle, cheatgrass, rubber rabbitbrush, snakeweed, horsebrush, and annual weeds.

When the range is in its highest potential condition, annual yields of usable forage range from 450 pounds per acre, air dry, in a favorable year to 225 pounds in a less favorable year.

SEMIDESERT STONY HILLS (PINYON-JUNIPER)

This range site is made up of only one soil—Mellenthin very rocky fine sandy loam, 4 to 25 percent slopes. This reddish-brown, shallow or very shallow, very rocky and very stony soil is medium textured and well drained. It overlies sandstone and is in areas of broken topography. The soil lies next to the breaks into the steep canyons or is adjacent to rolling areas, where little or no eolian material has been deposited. One area is 6 miles south of Blanding and about a quarter of a mile east of State Highway 47. Elevations range from 5,500 to 6,000 feet, and slopes range from 4 to 25 percent.

This soil has many angular fragments of flagstone on the surface and throughout the profile. Bedrock outcrops in many places.

In the areas where this range site occurs, the average precipitation is 8 to 12 inches per year. This is about 4 inches less precipitation per year than is recorded at Blanding. About 57 percent of the precipitation falls during the period when forage plants are growing, and about 43 percent, during the period when the plants are dormant. Except for May and June, which are drier than the other months of the year, the monthly precipitation is fairly uniform.

For the earliest forage plants that grow on this range site in cool weather, the growing season starts about March 15, and the seed usually matures by July 1 to July 15. Most of the time, enough precipitation falls during the summer and fall for these plants to become green again. Galleta, blue grama, and other plants that grow in warm seasons, start their growth between May 1 and May 15. Their seed generally matures between August 1 and August 15. The average frost-free period is 150 days.

The estimated density of the forage plants on this range site is 5 to 10 percent. The overstory is 80 to 90 percent juniper, but there are a few pinyon pines. The trees are in a fairly open stand that allows an understory of grass, shrubs, and forbs to grow. Indian ricegrass, needle-and-thread, squirreltail, tall native bluegrass, and other decreaser grasses make up 25 to 35 percent of the understory. Increaser grasses, such as galleta, blue grama, bullgrass, and sand dropseed, comprise 10 to 20 percent. Astragalus, deathcamas, aster, phlox, daisy, globemallow, and other broad-leaved herbs make up approximately 10 percent.

Black sagebrush, big sagebrush, winterfat, fourwing saltbush, ephedra, squaw-apple, birchleaf mahogany, and other shrubs, together with young pinyon pines and junipers, make up 25 to 45 percent of the potential vegetation. Common invaders are three-awn, Russian-thistle, annual weeds, cheatgrass, snakeweed, rubber rabbitbrush, and cactus.

When the range is in its highest potential condition, annual yields of forage range from 200 pounds per acre, air dry, in a favorable year to 40 in a less favorable year.

The stands of juniper produce some posts. The poor condition of this range site, however, does not favor production of a large number of high-quality posts.

Practices for rangeland

Practices that apply to the rangeland in this Area are proper grazing, rotation-deferred grazing, proper distribution of grazing, seeding of suitable grasses or legumes, and control of brush and weeds.

Control of grazing.—Experience has shown that when not more than half of the yearly volume of key forage plants are grazed, these better forage plants are able to maintain their growth and vigor. This is a general rule of thumb because some plants will withstand greater use than others. On slopes of 40 percent or less, the important kinds of range plants need about 50 percent of each year's growth of leaves to maintain themselves and to produce maximum amounts of forage. On slopes of more than 40 percent the proportion of top growth left should be increased 15 percent for each 10 percent of increase in slope. Areas having slopes of more than 70 percent are generally too steep to be grazed.

The forage left on the range has the following values:

1. Serves as a mulch that encourages the rapid intake and storage of water; the more water stored in the soil, the better the growth of plants for grazing.
2. Allows the roots of grass to reach the moisture deep in the soil; the roots of grass that has been overgrazed cannot reach deep into the soil, because not enough green shoots have been left to provide the food needed for the roots to grow well.
3. Protects the soil from erosion by wind and water; grass is the best kind of cover for preventing erosion.
4. Enables plants to store food so that they will make quick and vigorous growth in spring and after periods of drought.
5. Holds snow where it falls so that it soaks into the soil when it melts; snow that has been blown into drifts melts where it is of little benefit to other areas of the range.
6. Provides a greater reserve of feed for the dry spells that otherwise might force the rancher to sell his livestock at a loss.

Good range management requires that grazing be adjusted from season to season to match the amount of forage produced. The range operator needs to provide reserve pastures or other feed for use during periods of drought or at other times when the production of forage has been curtailed. This permits moderate grazing of the forage at all times. Besides having a reserve of forage and feed, the operator may want to keep some stocker steers or other readily salable stock on hand. Such flexibility allows the rancher to balance the number of livestock he keeps on hand with the production of forage without sacrificing breeding animals.

Native rangelands will need to be supplemented with feed concentrates and hay, and with forage from tame pastures. The operator needs to keep a supply of supplementary feed on hand to keep livestock in good condition throughout the year.

A breeding program needs to be planned to provide for the type of livestock that will be suitable for the range. It should be planned so that calves, lambs, or kids will arrive at a time when the forage is the most nutritious. Culling nonproductive animals from the herds is a necessary part of good range management. Culling undesirable animals can mean an overall increase in production and can contribute greatly to the improvement of the range.

Rotation-deferred grazing.—Good range management requires that the intensity of grazing use be adjusted from season to season in accordance with the amount of forage produced. Except on the Semidesert range sites in the southwestern part of the Area, the efficiency of range use can be increased 30 to 40 percent if a system of rotation-deferred grazing is followed on the range sites of this Area. Under this system of range management, the livestock graze on several different parts of the range for short periods. Generally, under this system, no area is grazed at the same time in successive years.

Rotation-deferred grazing meets the growth requirements of the choice forage plants by resting the range at intervals during the growing season. This encourages their increase in the stand. The intervals can be arranged to allow a good seed crop of the preferred forage plants to mature. After the seed is mature and the plants approach dormancy, the range can be grazed. Then, livestock will scatter the ripened seed and will trample it into the soil. A range that is grazed closely early in spring needs to be rested at least during the last half of the growing season. A recovery period late in the growing season will permit seedlings and young plants to survive and grow.

Before turning livestock onto the range in spring or fall, it is advisable to wait until the soil is dry and firm enough so that the forage plants will not be damaged and the soil puddled by trampling. The new growth of grass should be well underway before livestock are allowed to graze it. This applies when a system of rotation-deferred grazing is being practiced. This system allows for earlier starting of grazing on the range than does a year-long system of grazing.

Winter grazing is practiced only in the southern part of the Area on the Semidesert range sites. If sheep are allowed to graze throughout the winter and into spring, special care should be used to keep the animals from overgrazing the forage plants. Grazing a range during the early period of plant growth damages the high-yielding forage plants severely. Where the animals graze throughout the growing season of the plants, a system of rotation-deferred grazing that rests from one-third to two-thirds of the winter range during the early growth period every year will help the desirable forage plants to regain their health and vigor. The deferred areas can then be grazed when the plants are dormant.

Year-long range for cattle should be fenced into three or more pastures to protect the range area from grazing during the early period of plant growth (fig. 8). This improves the range and increases the yield of forage.

Resting different areas of range, in turn, throughout the spring and summer growing season allows the deferred range site to develop very good forage. Range that is grazed during the critical periods late in spring or early in summer can be deferred throughout the entire growing season the following year.

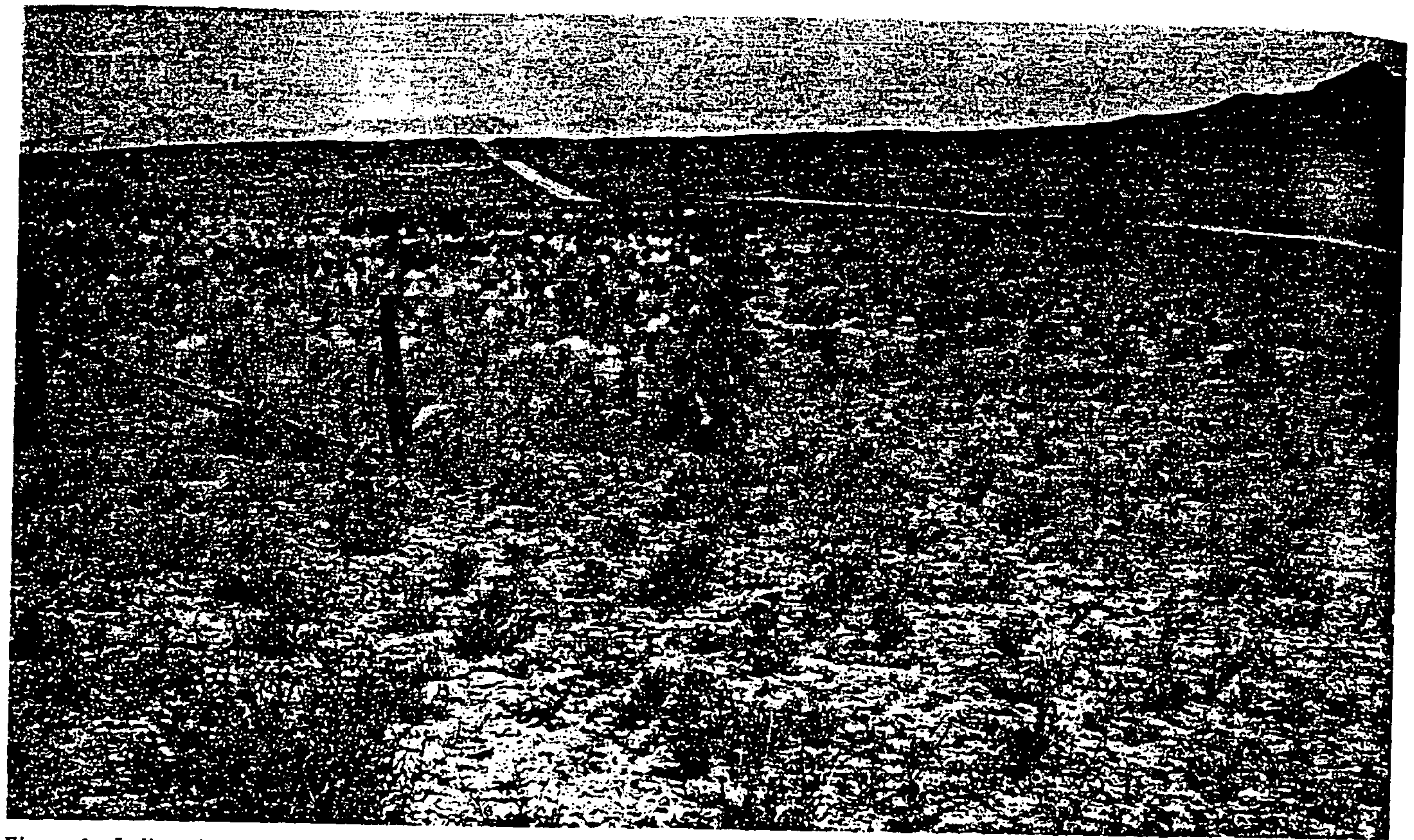

Figure 8.—Indian ricegrass and Brigham tea growing in an area that was protected from grazing when the plants were making their early growth. Russian-thistle and snakeweed are on ~~the outside of~~ the fence, in an area that was grazed at the time the forage plants were making their early growth.

Distribution of grazing.—To get better distribution of livestock on the range and uniform use of forage, the following practices are helpful:

Adequate and dependable sources of water for stock should be located in each pasture so that the livestock will not have to walk far. Wells, ponds, springs, or pipelines usually can be provided to supply water, but in some places water may need to be hauled. Moving the tanks from time to time will allow the trampled areas around the watering places to recover and produce forage again. The characteristics of the range will determine the most practical source of water to use.

Placing salt at a distance from the watering places and moving its location occasionally will cause livestock to scatter out over the range and thus use the range more uniformly. The salt can be moved at intervals to a place where more grazing of the forage is desired.

Proper fencing is necessary to separate different kinds of livestock and to separate different units of range so that no area will be grazed continuously. It is used primarily for cattle because sheep are herded. In some places separating different range sites may be desirable if the differences in the quality of the forage are great enough to warrant separation, or if the areas are too large to be managed easily.

Range seeding.—Range seeding consists of establishing perennial grasses or legumes on rangeland. It helps to restore ranges that are in poor condition and establishes forage plants on soils that have been converted to range from other uses. The plants that are seeded also protect the soils from erosion.

Seeding increases the amount of forage quickly on ranges that are in poor condition. A good stand of grasses and browse plants that has been gained by seeding can increase the amount of forage on the range several times over. Seeding is advisable if the vegetation is so depleted that it cannot recover within a reasonable time by using only the usual management practices (fig. 9).

Some range sites on which the vegetation provides only poor-quality forage can be plowed and seeded to more desirable grasses and browse plants. The seeding mixture may consist of suitable kinds of native grasses, browse plants, and legumes, or wheatgrasses that tolerate drought may be introduced. Generally, a combination of plants, such as those that make up the potential vegetation, grow better together than any one species grown alone. Experience has shown, however, that seeding one kind of grass or one kind of browse is more effective than seeding mixtures in providing for proper range use. The range sites where seeding can be done when it is desirable to do so are Semiwet Meadow; Upland Loam; Upland Loam (Pinyon-Juniper); Upland Clay; Upland Clay (Pinyon-Juniper); and Semidesert Loam.

Control of brush and weeds.—Removal of undesirable brush and weeds through mechanical or chemical means is needed on most of the range sites of this Area. Controlling the brush and weeds helps to improve the quality of the forage on the range. It also makes the handling of livestock easier.

Figure 9.—An area that formerly consisted of depleted rangeland and of woodland used for range. The area has been cleared and seeded to suitable forage plants.

On some sites valuable forage plants are still fairly abundant, but big sagebrush, rabbitbrush, or snakeweed is dominant. On these sites controlling the undesirable plants and then deferring grazing for 2 or more years will help to improve the condition of the range more rapidly than if the undesirable plants are not controlled. The undesirable plants can be eradicated or controlled by using a chemical spray or by rotobeating or railing. Railing is the least desirable of these methods because the number of undesirable plants that are killed is low.

Descriptions of Soils

Described briefly in this section are the soil series (groups of soils that are much alike) and the mapping units that are shown on the soil map at the back of the report. The descriptions are somewhat technical. Therefore, it may be helpful to the reader to refer to the section "How Soils are Named, Mapped, and Classified," where series, type, phase, and other special terms are discussed. The approximate acreage and proportionate extent of each mapping unit are given in table 7.

For each series, a detailed profile is described that is considered typical of the soils in that series. The major horizons, or layers, in the profile are designated by letters, for example, A, B, and C. Subdivisions of these major horizons are indicated by subscript letters or numbers, such as A_p, A_1, B_1, B_2, or B_3. These subdivisions are made if there is a worthwhile difference in the color, texture, structure, or consistence of the soil materials in a major horizon.

By studying the profiles, soil scientists learn much about the behavior of soils. Farmers, ranchers, foresters, and others who work with soils can also judge the behavior of the soils and can tell how to use them more effectively. Following are some of the characteristics observed that are important.

Color and content of organic matter.—Color is normally related to the amount of organic matter in the soil. Soils that are dark colored generally contain more organic matter than soils that are light colored. This difference in color was caused largely by the kind and amount of vegetation that grew on the soils when they were forming. Soils formed under grasses generally have a dark-colored surface layer because the grasses have added more organic matter than was added to soils formed under trees. Grayish and whitish colors or streaks or spots of yellow and brown often indicate poor drainage or poor aeration.

In this report the color of the soil is described in two ways. First, it is indicated by a descriptive term. Then, it is also indicated by a Munsell notation, such as 5YR 5/3. The Munsell notation denotes color more precisely than is possible by the use of words. Unless otherwise stated, the color given is that of moist soil.

Texture.—The texture of the soil, or the proportionate content of sand, silt, and clay, is determined by the way the soil feels when rubbed between the fingers. Samples are checked later by mechanical analysis in the laboratory. Texture helps determine how well the soil retains moisture, plant nutrients, and fertilizer, and whether it is easy or difficult to cultivate. The terms used for textural classes are sand, loamy sand, sandy loam, loam, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay.

Structure.—Structure is an important characteristic of a soil. It is the way individual particles of soil are arranged, or grouped, in larger aggregates. These soil aggregates may be granular, blocky, or platelike, or they may have other forms. The size of the aggregates, their shape, and the pore space between them determine how well water and air move through the soil and how easily roots can penetrate. In sandy soils, for example, water and air move readily but little water is held for plants. Clayey soils take water slowly but hold more of it.

In soils that have a granular structure, the granules fit together loosely like bread crumbs; the pores are many and are both small and large. Consequently, granular structure is generally desirable.

In soils that have a blocky structure, the aggregates are laid together much like stacked bricks. Some of the blocks are square, others are rectangular, and still others are irregular (subangular) in shape. The blocks range from 1/10 inch to 3 inches in diameter. Soils that have a blocky structure are generally high in clay; water infiltrates through them slowly, and roots have difficulty in penetrating. These soils are likely to remain wet and cold until late in spring. If these soils are tilled when wet, clods form when the soils dry out and it is difficult to prepare a good seedbed. Clayey soils may also puddle after a rain. As a result, much soil is washed away with the water that runs off.

Consistence.—The consistence of a soil is closely related to its texture. By consistence is meant the feel of the soil material when the soil is rubbed between the fingers. Some terms used to describe consistence are "friable," to describe consistence when the soil is moist; "plastic," to describe consistence when the soil is wet; and "hard," to describe consistence when the soil is dry. Most soils that have a loamy texture and granular structure are also friable. A friable soil is more desirable for agriculture than one that is firm, very firm, or loose. It can be worked easily and generally will make a good seedbed.

Other characteristics observed when the soils are studied in the field include the following: Depth of the soil over hard rock, cemented or compacted layers, or layers of loose gravel; occurrence of gravel or stones in amounts that will interfere with tillage or with the use of the soil; the steepness and pattern of slopes and the degree of erosion; the runoff of surface water, drainage through the soil, and occurrence of a shallow water table; the nature of the underlying rock or other parent material from which the soil has formed; and the kind and amount of vegetation. Observations made in the field are supplemented by laboratory tests in which the acidity, alkalinity, or salinity of the soils is determined. In this report the soil reaction is expressed in pH values of soil paste.

TABLE 7.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent
Abajo loam, 0 to 10 percent slopes	6, 535	1. 9
Abajo cobbly loam, 2 to 25 percent slopes	4, 064	1. 2
Abajo cobbly clay loam, 10 to 25 percent slopes	437	. 1
Ackmen silt loam, 0 to 6 percent slopes, moderately eroded	5, 323	1. 5
Ackmen silt loam, 0 to 6 percent slopes	476	. 1
Ackmen silt loam, 0 to 6 percent slopes, severely eroded	1, 765	. 5
Ackmen silt loam, moderately deep water table, 0 to 3 percent slopes	178	. 1
Ackmen loam, 0 to 6 percent slopes	923	. 3
Ackmen loam, 0 to 10 percent slopes, moderately eroded	571	. 2
Ackmen loam, 0 to 10 percent slopes, severely eroded	466	. 1
Ackmen silty clay loam, moderately deep over gravel, 2 to 25 percent slopes	98	(1)
Blanding very fine sandy loam, 2 to 10 percent slopes	6, 823	1. 9
Hovenweep loam, 2 to 6 percent slopes	2, 993	. 9
Lockerby silty clay loam, 2 to 6 percent slopes, moderately eroded	1, 299	. 4
Lockerby and Hovenweep soils, 2 to 6 percent slopes	14, 877	4. 2
Lockerby and Hovenweep soils, 6 to 10 percent slopes	208	. 1
Lockerby and Menefee soils, 2 to 10 percent slopes	524	. 1
Mellenthin very rocky fine sandy loam, 4 to 25 percent slopes	5, 373	1. 5
Menefee clay loam, 2 to 25 percent slopes	14, 379	4. 1
Menefee shaly clay loam, 2 to 25 percent slopes	619	. 2
Menefee cobbly clay loam, 4 to 40 percent slopes	2, 693	. 8
Monticello very fine sandy loam, 0 to 10 percent slopes	44, 686	12. 7
Monticello very fine sandy loam, low rainfall, 2 to 10 percent slopes	15, 577	4. 4
Monticello-Hovenweep complex, 2 to 10 percent slopes	920	. 3
Monticello-Hovenweep complex, low rainfall, 2 to 10 percent slopes	2, 092	0. 6
Montvale very rocky very fine sandy loam, 2 to 25 percent slopes	75, 737	21. 6
Northdale loam, 0 to 6 percent slopes	38, 357	10. 9
Northdale loam, 6 to 10 percent slopes	2, 150	. 6
Northdale loam, low rainfall, 0 to 6 percent slopes	48, 527	13. 8
Northdale loam, low rainfall, 6 to 10 percent slopes	1, 250	. 4
Northdale loam, 2 to 10 percent slopes, severely eroded	286	. 1
Pack silt loam, 2 to 6 percent slopes	464	. 1
Pack silt loam, moderately deep water table, 0 to 3 percent slopes	122	(1)
Pack cobbly silt loam and silt loam, 2 to 6 percent slopes	165	(1)
Sandstone rockland, sloping	675	. 2
Sandstone rockland, steep	28, 648	8. 2
Scorup very fine sandy loam, 2 to 6 percent slopes	4, 028	1. 1
Scorup cobbly very fine sandy loam, 2 to 25 percent slopes	3, 778	1. 1
Shay clay loam, 0 to 3 percent slopes	743	. 2
Shay clay loam, 0 to 3 percent slopes, severely eroded	412	. 1
Ucolo silty clay loam, 0 to 3 percent slopes	206	. 1
Ucolo silty clay loam, 2 to 10 percent slopes, moderately eroded	7, 299	2. 1
Ucolo silty clay loam, 0 to 3 percent slopes severely eroded	528	. 1
Vega clay loam, 0 to 6 percent slopes	427	. 1
Vega clay loam, 0 to 6 percent slopes, moderately eroded	1, 807	. 5
Vega clay loam, 0 to 3 percent slopes, severely eroded	1, 310	. 4
Vega clay loam, moderately deep water table, 0 to 3 percent slopes	409	. 1
Total	351, 227	100. 0

[1] Less than 0.1 percent.

Abajo Series

The Abajo series consists of well-drained, dark reddish-brown soils that are fine textured to moderately fine textured. The soils are either cobbly throughout, or cobblestones are at a moderate depth. The surface layer, except in the cobbly soils, is dark reddish brown and has formed in wind-laid material. The subsoil is reddish-brown or dark-brown clay or cobbly clay loam.

These soils are mainly in the western part of the Area, north and south of Monticello. They are at elevations ranging from 6,500 to 7,100 feet. In places the soils are on cones that make up the lower foothills of the Abajo Mountains. In other places they are on fans in which streams have cut channels 20 to 100 feet deep. Underlying the soils in most places are dark-colored, igneous rocks (diorite, andesite, dacite, and trachyte porphyries), but in a few places the soils are underlain by sandstone. Slopes range from about 0 to 25 percent.

In these soils the permeability of the subsoil is slow, and surface runoff is slow to medium. The available moisture-holding capacity is high, and the soils are high in inherent fertility. These soils are moderately susceptible to water and wind erosion.

The vegetation on the Abajo soils consists mainly of oakbrush, bitterbrush, big sagebrush, western wheatgrass, native bluegrass, junegrass, and a few ponderosa pines.

The Abajo soils are used for range and for dryfarming. Near Monticello and Old La Sal, they are used for irrigated farming to a limited extent. Small grains, alfalfa, and forage plants grown on improved pastures are the main crops.

Abajo loam, 0 to 10 percent slopes (AbD).—The following describes a profile in a recent road cut about 3 miles south of Monticello, along State Highway 47:

A_{11} 0 to 2 inches, dark reddish-brown (5YR 3/3) loam, brown (7.5YR 5/2) when dry; weak, medium, platy structure that breaks to weak, thin, platy; slightly hard when dry, friable when moist; a few fine roots; a few fine pores; organic matter 2.0 percent noncalcareous; pH about 7.1; abrupt, smooth boundary.

A_{12} 2 to 10 inches, dark reddish-brown (5YR 3/4) sandy clay loam, reddish brown (5YR 4/3) when dry; weak, angular blocky structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; numerous fine roots; a few fine pores; organic matter 1.6 percent; noncalcareous; pH about 7.2; clear, wavy boundary.

B_{21} 10 to 20 inches, reddish-brown (5YR 4/4) clay, reddish brown (5YR 5/4) when dry; moderate, continuous clay films; moderate, fine, prismatic structure that breaks easily to moderate, fine, subangular blocky; extremely hard when dry, very firm when moist, very plastic and sticky when wet; a few roots; a few fine pores; noncalcareous; pH about 7.1; clear, wavy boundary.

B_{22} 20 to 40 inches, dark-brown (7.5YR 4/4) cobbly clay loam, brown (7.5YR 5/4) when dry; moderate, medium, prismatic structure that breaks to moderate, fine and very fine, subangular blocky; thick, continuous clay films; extremely hard when dry, very firm when moist, very sticky and plastic when wet; a few roots; some of the cobblestones are highly weathered; slightly calcareous; pH about 7.7; clear, wavy boundary.

C_1 40 to 50 inches, dark-brown (7.5YR 4/4) cobbly clay loam, brown (7.5YR 5/4) when dry; massive; very hard when dry, very firm when moist, very sticky and plastic when wet; cobblestones are highly weathered; slightly calcareous; pH about 8.2.

This is the most extensive soil in the Abajo series. It is used mainly for crops, but some areas are in range. The soil is easy to till, absorbs moisture readily, and retains it well. It is in capability unit IIIc-1 and in the Upland Loam and Upland Loam (Pinyon-Juniper) range sites.

Abajo cobbly loam, 2 to 25 percent slopes (AbGC).—This soil is similar to Abajo loam, 0 to 10 percent slopes, but it has cobblestones throughout the profile and the surface layer contains less windblown material. Also, in most places, this soil has stronger slopes than Abajo loam, 0 to 10 percent slopes. This soil is used for range or consists of woodlands used for range. It is in the Upland Loam and Upland Loam (Pinyon-Juniper) range sites.

Abajo cobbly clay loam, 10 to 25 percent slopes (AcGC).—This soil occurs near Monticello on sloping and dissected old stream terraces. Except for the texture of the surface layer, it is similar to Abajo cobbly loam, 2 to 25 percent slopes. The finer texture of the surface layer probably indicates that the parent material was derived partly from materials weathered from shale. This soil is used for range or consists of woodlands used for range. It is in the Upland Loam and Upland Loam (Pinyon-Juniper) range sites.

Ackmen Series

The Ackmen series consists of deep, well-drained, medium-textured soils that are noncalcareous to slightly calcareous. The soils formed in alluvium. They are mainly on narrow, entrenched flood plains adjacent to intermittent and perennial streams. The surface layer is very dark brown, noncalcareous loam or silt loam, and the subsoil is dark-brown loam.

The Ackmen soils are widely distributed in rather small tracts throughout much of the Area. They are at elevations ranging from about 5,800 feet to 7,000 feet. Slopes are mainly between 0 and 10 percent, but, in a few places, they are as much as 25 percent. The parent material was derived partly from local sedimentary rocks, partly from eroded, adjacent upland soils, and partly from eroded soils of mountains outside the Area.

Permeability is moderate in these soils, and runoff is slow. The available moisture-holding capacity is high, and the soils are high in inherent fertility. They are easy to till, and they absorb moisture readily. These soils are moderately susceptible to water and wind erosion.

The Ackmen soils are associated with Abajo, Monticello, Northdale, and Montvale soils. The vegetation on the Ackmen soils consists of oakbrush, big sagebrush, rabbitbrush, western wheatgrass, and native bluegrass.

The soils of this series are used mainly for dryfarming or range, but small tracts are irrigated.

Ackmen silt loam, 0 to 6 percent slopes, moderately eroded (AsC2).—The following describes a profile in a recent gully about 0.9 mile east of Peters Spring (NE¼ sec. 25, T. 32 S., R. 23 E.):

A_{11} 0 to 3 inches, very dark brown (10YR 2/3) silt loam, dark grayish brown (10YR 4/2) when dry; weak, thin, platy structure that breaks to weak, medium, granular; soft when dry, very friable when moist; noncalcareous; a few fine, medium, and large roots; very few fine pores; pH about 7.6.

A_{12} 3 to 7 inches, very dark brown (10YR 2/3) silt loam, dark brown (10YR 4/3) when dry; weak, thick, platy structure breaking to weak, medium, granular; hard when dry, friable when moist; many fine and a few medium and large roots; few fine pores; noncalcareous; pH about 7.5; 3 to 9 inches thick.

C_1 7 to 32 inches, dark-brown (7.5YR 3/2) loam, dark brown (7.5YR 4/2) when dry; weak, medium and coarse, prismatic structure breaking to very fine, subangular blocky; very hard when dry, friable when moist; a few fine, medium, and large roots; many fine and a few medium pores; noncalcareous; pH about 7.7.

C_2 32 to 71 inches, dark-brown (7.5YR 3/2) loam, dark brown (7.5YR 4/2) when dry; massive to weak, prismatic structure; very hard when dry, friable when moist; a few large roots; noncalcareous; pH 7.4.

The content of organic matter in the surface horizon ranges from 2.0 to about 3.6 percent. Textural stratification is common, and in places there is a thin, recent overwash of fine sandy loam. In areas where the parent material was derived largely from eroding Monticello soils, the surface layer is slightly redder in color than that of the typical soil.

This soil has a few deep gullies that formed in recent times. It became gullied when the range was depleted or when surrounding areas were cultivated. The soil adjacent to the gullies is used chiefly for dryfarming, but small areas are used for irrigated farming. This soil is in the Upland Loam range site.

Ackmen silt loam, 0 to 6 percent slopes (AsC).—This soil is like Ackmen silt loam, 0 to 6 percent slopes, moderately eroded, except that it contains fewer gullies. It is used chiefly for irrigated farming or for dryfarming. This soil is in capability unit IIIc-3 and in the Upland Loam range site.

Ackmen silt loam, 0 to 6 percent slopes, severely eroded (AsC3).—This soil is severely gullied and is of little use for crops or grazing. Except that erosion has been severe, it is similar to Ackmen silt loam, 0 to 6 percent slopes, moderately eroded. The soil is in the Upland Loam range site.

Ackmen silt loam, moderately deep water table, 0 to 3 percent slopes (AsBW).—The profile of this soil is similar to that of Ackmen silt loam, 0 to 6 percent slopes, moderately eroded, except that there are a few, faint mottles in the lower part of the substratum. The soil is of minor extent and is mainly about 2 miles east and about a quarter of a mile north of Monticello. It is in a lower position than areas in the vicinity of Monticello that have been irrigated. The soil contains a water table, which probably owes its origin to drainage water from higher lying, irrigated areas.

This soil is used for range. It is in the Semiwet Meadow range site.

Ackmen loam, 0 to 6 percent slopes (AlC).—This soil is most extensive in the vicinity of La Sal. It occurs on a fairly broad alluvial fan and is used for general irrigated farming. Other areas are along Recapture Creek and its tributaries, north of Blanding. The profile of this soil is similar to that of Ackmen silt loam, 0 to 6 percent slopes, moderately eroded, but this soil contains considerably less silt, both in the surface layer and throughout the profile. It also contains somewhat more lime at a depth below about 24 inches. This soil is in capability unit IVc-2 and in the Upland Loam range site.

Ackmen loam, 0 to 10 percent slopes, moderately eroded (AlD2).—This soil is like Ackmen silt loam, 0 to 6 percent slopes, moderately eroded, but it has less silt throughout the profile. In the narrow valleys of streams, deep gullies cut through the center of the valleys are characteristic. This soil is in the Upland Loam range site.

Ackmen loam, 0 to 10 percent slopes, severely eroded (AlD3).—Like Ackmen silt loam, 0 to 6 percent slopes, severely eroded, this soil is severely gullied and has little value for agriculture. It contains less silt than Ackmen silt loam, 0 to 6 percent slopes, severely eroded. This soil is in the Upland Loam range site.

Ackmen silty clay loam, moderately deep over gravel, 2 to 25 percent slopes (AyG).—This soil occurs in the vicinity of Monticello in association with Abajo cobbly loam, 2 to 25 percent slopes. It consists of stratified alluvium that overlies a buried, cobbly Abajo soil. This soil is suitable for range. It is in the Upland Loam range site.

Blanding Series

The Blanding series consists of deep, reddish-brown, well-drained, medium-textured soils developed in wind-laid materials in areas of low rainfall. The surface (A_1) horizon is thin and consists of reddish-brown very fine sandy loam that is 4 to 6 inches thick. It overlies yellowish-red fine sandy clay loam. The soils are on gently undulating to rolling uplands in the extreme southern part of the Area at elevations of from 5,000 to 6,000 feet. Their slopes range from about 2 to 10 percent.

The Blanding soils are moderately permeable and have slow surface runoff. Their inherent fertility is moderately high. The soils are easy to till, absorb moisture readily, and have high moisture-holding capacity. They are moderately susceptible to water and wind erosion.

The Blanding soils are associated with Mellenthin soils. They are similar to the Monticello soils.

The vegetation on the Blanding soils consists mainly of galleta, Indian ricegrass, squirreltail, blue grama, big sagebrush, rabbitbrush, and snakeweed. Some areas, once used for dryfarming, have been abandoned and are now covered by annual weeds, rabbitbrush, snakeweed, sagebrush, and cheatgrass.

Only one soil of this series is mapped in the Area.

Blanding very fine sandy loam, 2 to 10 percent slopes (BnD).—The following describes a profile of this soil in an area that has not been cultivated. The sampling site is about 6.5 miles south and 0.4 mile west of Blanding (NE¼ sec. 33, T. 37 S., R. 22 E.):

A_1 0 to 4 inches, reddish-brown (5YR 4/4) very fine sandy loam, reddish brown (5YR 5/4) when dry; weak, thin and medium, platy structure; slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; many fine roots; noncalcareous; pH 8.1; abrupt, wavy boundary.

B_2 4 to 16 inches, yellowish-red (5YR 3/6) sandy clay loam, yellowish red (5YR 5/6) when dry; weak, coarse, prismatic structure that breaks to very weak, medium, subangular blocky; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many fine roots; a few fine pores; noncalcareous; pH 7.7; clear, wavy boundary.

C_{ca} 16 to 50 inches, yellowish-red (5YR 4/6) sandy clay loam, reddish yellow (5YR 6/6) when dry; moderate, medium, subangular blocky structure; extremely hard when dry, firm when moist, slightly sticky and slightly plastic when wet; a few fine roots; very few fine pores; moderately calcareous; pH 8.1; clear, smooth boundary.

B_{2b} 50 to 58 inches, yellowish-red (5YR 4/6) sandy clay loam, reddish yellow (5YR 6/6) when dry; moderate, medium, subangular blocky structure; very hard when dry, firm when moist, slightly sticky and slightly plastic when wet; slightly calcareous; pH 8.2; 8 to 10 inches thick.

C_{cab} 58 to 68 inches, yellowish-red (5YR 5/6) sandy clay loam; light reddish brown (5YR 6/4) when dry; massive; very hard when dry, firm when moist, slightly sticky and slightly plastic when wet; strongly calcareous; pH 8.3.

The content of organic matter in this soil is low, or from about 0.5 percent to 1.0 percent. At depths ranging from 4 to 6 feet, there is a buried soil that somewhat differs from this soil. The buried C_{cab} horizon generally contains a strong horizon of lime. In areas where Blanding very fine sandy loam, 2 to 10 percent slopes, merges with the Mellenthin soils, sandstone bedrock occurs in many places in the deeper horizons.

Blanding very fine sandy loam, 2 to 10 percent slopes, is used entirely for range. It is unsuited to dryfarming. If water were provided for irrigation, however, this soil would be well suited to general irrigated farming. It is in the Semidesert Loam range site.

Hovenweep Series

The Hovenweep series consists of moderately deep, well-drained soils that are medium textured to moderately fine textured. The soils have formed in wind-laid sediments overlying materials derived from decomposing shale. They occupy a fairly large acreage in the central part of the Area and are at elevations of from 6,500 to 6,800 feet. The soils are on undulating to rolling uplands and have slopes ranging from 2 to 10 percent. More than 50 percent of the horizon of shaly material underlying the soils is lime.

These soils are moderately susceptible to water and wind erosion. They have slow permeability and slow to medium runoff. The soils are moderate in available moisture-holding capacity. They are easy to till and absorb moisture readily. Their inherent fertility is moderate.

The Hovenweep soils are associated with Lockerby, Monticello, Northdale, Menefee, and Ucolo soils. In areas where the Hovenweep soils are associated with Menefee and Ucolo soils, the Menefee soils are on the tops of ridges and hills, the Hovenweep soils are immediately below the ridges, and the Ucolo soils are in swales.

The vegetation on the Hovenweep soils consists chiefly of pinyon, juniper, western wheatgrass, and big sagebrush, but there is some oakbrush and bitterbrush.

Hovenweep soils are used for dryfarming, range, and woodland. In areas used for range, some stands of selected grasses have been established.

Hovenweep loam, 2 to 6 percent slopes (HlC).—The following describes a profile of this soil about 1.4 miles north of U.S. Highway No. 160, on the West Summit Point Road (SW¼ of sec. 31, T. 33 S., R. 26 E.):

A_{11} 0 to 2 inches, dark reddish-brown (5YR 3/3) loam, reddish brown (5YR 4/3) when dry; vesicular pores; very weak, thin, platy structure that breaks to weak, fine, granular; soft when dry, very friable when moist; no roots; slightly calcareous; pH about 8.0; abrupt, smooth boundary.

A_{12} 2 to 5 inches, dark reddish-brown (5YR 3/3) loam, reddish brown (5YR 4/3) when dry; moderate, thick, platy structure; hard when dry, friable when moist; a few fine roots; moderately calcareous; pH about 7.7.

A_{13} 5 to 10 inches, dark reddish-brown (5YR 3/3), heavy loam, reddish brown (5YR 4/3) when dry; weak, medium, subangular blocky structure; slightly hard when dry, friable when moist; a few large and many fine roots; a few small and large pores; very strongly calcareous and has veining of lime; pH 8.0.

AC 10 to 15 inches, dark-brown (7.5YR 4/2) clay loam, pinkish gray (7.5YR 6/2) when dry; weak to moderate, subangular blocky structure; hard when dry, firm when moist; many large, medium, and fine roots; a few fine pores; very strongly calcareous and has prominent, large veins of lime; pH about 8.1.

C_{ca1} 15 to 22 inches, grayish-brown (2.5Y 5/2) clay loam, light gray (2.5Y 7/2) when dry; weak to moderate, subangular blocky structure; hard when dry, firm when moist; a few fine roots; very strongly calcareous; pH about 8.3.

C_{ca2} 22 to 32 inches, grayish-brown (2.5Y 5/2) clay loam, light gray (2.5Y 7/2) when dry; massive to very weak, medium, subangular blocky structure; very hard when dry, very firm when moist; no roots; extremey calcareous; pH about 8.3.

D_{rca} 32 to 38 inches, grayish-brown (2.5Y 5/2), partially decomposed shale, light gray (2.5Y 7/2) when dry; pH about 8.1; extremely calcareous.

The thickness of the soil above the shale ranges from about 20 to 36 inches. The content of organic matter in the surface (A_1) horizon ranges from about 2.0 to 2.7 percent. The depth to a strong lime horizon ranges from 10 to 18 inches, and the content of lime ranges from about 30 to 60 percent.

This soil is used for both dryfarming and for range. It is suited to grass. The soil is in capability unit IVc-3 and in the Upland Loam and the Upland Loam (Pinyon-Juniper) range sites.

Lockerby Series

The Lockerby series consists of fine-textured, moderately well drained soils that are moderately deep over Mancos shale. The surface (A_1) horizon is a dark-brown silty clay loam and is underlain by dark-brown silty clay (C_1). Soluble salts increase in the lower C horizon, above the parent rock. The soils are on smooth to gently rolling uplands, mainly in the northeastern part of the Area at elevations ranging from about 6,500 to 6,800 feet. They have slopes ranging from 2 to 10 percent.

The parent material of these soils weathered mainly from the underlying gray Mancos shale. The dark-brown color in the upper part of the profile indicates, however, that reddish-brown, wind-laid materials were mixed with the shale.

These soils are moderately susceptible to water and wind erosion. Permeability is slow to very slow, runoff is medium to rapid, and the moisture-holding capacity is moderate. Inherent fertility is low.

The Lockerby soils are associated with Hovenweep, Menefee, and Ucolo soils. In the north-central part of the Area, the Lockerby silty clay loams and Hovenweep loams are so intricately associated that they were mapped together as undifferentiated soil groups. In other places in the Area, the Lockerby silty clay loams and Menefee clay loams were also mapped together as undifferentiated soil groups.

The vegetation on the Lockerby soils consists mainly of black sagebrush, birchleaf mahogany, squaw-apple, pinyon, juniper, fringed sagewort (fringed sagebrush), and western wheatgrass.

The Lockerby soils are used principally for range. In places good stands of grass have been established by seeding.

Lockerby silty clay loam, 2 to 6 percent slopes, moderately eroded (LyC2).—The following describes a profile about 12 miles east and 3 miles north of Monticello (NE¼ sec. 6, T. 33 S., R. 25 E.):

A_1 0 to 4 inches, dark-brown (10YR 4/3) silty clay loam, brown (10YR 5/3) when dry; weak, thin, platy structure that breaks readily to moderate, fine, granular; slightly hard when dry, friable when moist, sticky and plastic when wet; a few fine roots; a few fine pores; strongly calcareous; pH about 8.0; abrupt, smooth boundary.

AC 4 to 13 inches, dark-brown (10YR 4/3), heavy silty clay loam, brown (10YR 5/3) when dry; weak to moderate, medium, prismatic structure that breaks to moderate, fine, angular blocky; hard when dry, firm when moist, sticky and plastic when wet; many fine roots; many fine pores; very strongly calcareous; pH about 8.3; clear, wavy boundary.

C_1 13 to 26 inches, dark-brown (10YR 4/3) silty clay, brown (10YR 5/3) when dry; weak, coarse, prismatic structure to massive; extremely hard when dry, firm when moist, very sticky and very plastic when wet; a few fine roots; a few fine pores; very strongly calcareous; pH about 8.2; clear, wavy boundary.

C_2 26 to 38 inches, dark grayish-brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) when dry; massive; extremely hard when dry, firm when moist, very sticky and very plastic when wet; very few fine roots; very few fine pores; very strongly calcareous (24 percent $CaCO_3$); gypsum about 15 percent; exchangeable sodium 23 percent; pH about 8.1; gradual, wavy boundary.

D_r 38 to 52 inches, gray, decomposing Mancos shale; $CaCO_3$ equivalent, 25 percent; gypsum, 14 percent; exchangeable sodium, 14 percent.

In general, the texture of the surface (A_1) horizon ranges from silty clay loam to clay loam, but in a few places the texture is light silty clay. The color of the surface horizon ranges from dark brown to dark grayish brown. The depth to decomposing shale ranges from about 20 to 48 inches. In areas where Lockerby soils are adjacent to Hovenweep soils, the surface layer has been somewhat more influenced by loess. These soils are in the Upland Clay and Upland Clay (Pinyon-Juniper) range sites.

Lockerby and Hovenweep soils, 2 to 6 percent slopes (LHC).—The soils in this undifferentiated soil group are extensive in the central and northern parts of the Area. They occur on undulating to rolling uplands and are moderately deep over Mancos shale.

The Lockerby soil has a surface layer of silty clay loam. It is moderately well drained and is fine textured. The Hovenweep soil has a surface layer of loam and is well drained and medium textured to moderately fine textured. It has formed in eolian materials deposited on decomposing Mancos shale.

These soils are better suited to grass than to dry-farmed crops, but they are dry-farmed to some extent. The principal dry-farmed crop is wheat. The soils are in capability unit IVc-4 and in the Upland Clay and Upland Clay (Pinyon-Juniper) range sites.

Lockerby and Hovenweep soils, 6 to 10 percent slopes (LHD).—The soils in this undifferentiated soil group are similar to Lockerby and Hovenweep soils, 2 to 6 percent slopes, except that they have stronger slopes. The soils are used for range or consist of woodlands used for range. They are in the Upland Clay and Upland Clay (Pinyon-Juniper) range sites.

Lockerby and Menefee soils, 2 to 10 percent slopes (LMD).—The soils in this undifferentiated soil group are on rolling uplands in the west-central part of the Area. The Lockerby soil has a surface layer of silty clay loam. It is a fine-textured, moderately deep soil that overlies Mancos shale. The Menefee soil has a surface layer of clay loam. It is a shallow soil formed in materials weathered from Mancos shale. The soils are suited only to range. They are in the Upland Clay and Upland Clay (Pinyon-Juniper) range sites.

Mellenthin Series

The Mellenthin series consists of shallow to very shallow, very rocky, medium-textured, reddish-brown soils that are well drained. The soils overlie sandstone. Their surface (A_1) horizon is a reddish-brown very stony fine sandy loam. It is underlain by a strong horizon of lime, which, in turn, overlies fractured sandstone.

The Mellenthin soils occur only in the extreme southern part of the Area. They are on moderate to steep slopes and on the steep breaks of canyons at elevations ranging from 5,500 to 6,000 feet. The soils have slopes ranging from 4 to 25 percent. Their parent material was derived from weathered sandstone and from minor amounts of wind-deposited materials over the sandstone.

These soils have moderate permeability and medium runoff. Their moisture-holding capacity is low, and the soils are low in inherent fertility. They are moderately susceptible to water erosion.

The Mellenthin soils are associated with Blanding soils and with areas of Sandstone rockland.

The vegetation on the Mellenthin soils consists mainly of black sagebrush, big sagebrush, pinyon, juniper, snakeweed, Indian ricegrass, galleta, and sand dropseed.

The Mellenthin soils are used for range. Only one soil of this series is mapped in the Area.

Mellenthin very rocky fine sandy loam, 4 to 25 percent slopes (MeG).—The following describes a profile of this soil, about 6.25 miles south of Blanding and 500 feet east of the highway (near the southwestern corner of sec. 27, T. 37 S., R. 22 E.):

A_1 0 to 4 inches, reddish-brown (5YR 3.6/4) very stony fine sandy loam, reddish brown (5YR 5/4) when dry; weak, medium to thick, platy structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; few fine roots; very few fine pores; moderately calcareous; pH 8.0; abrupt, wavy boundary.

C_{ca1} 4 to 11 inches, reddish brown (5YR 4.6/4) loam, light reddish brown (5YR 6/3) when dry; very weak, medium, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few fine roots; few fine pores; very strongly calcareous; weakly cemented when dry, but fractured; numerous fragments of sandstone; pH 8.3; clear, wavy boundary.

C_{ca2} 11 to 15 inches, pink (5YR 7/4) loam, pink (5YR 8/3) to white (5YR 8/1) when dry; massive; extremely hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few fine roots; no pores; numerous fragments of sandstone; very strongly calcareous, with lime concentrated on the undersides of the fragments of sandstone; pH 8.1.

D_r 15 inches +, sandstone bedrock.

In many places this soil contains many angular fragments of sandstone, but the number of fragments varies widely from place to place. Small areas of exposed rock make up from 15 to 25 percent of the acreage.

This soil is used for range. It is in the Semidesert Stony Hills (Pinyon-Juniper) range site.

Menefee Series

The Menefee series consists of shallow, moderately fine textured, well-drained soils that overlie relatively hard, fractured shale. The soils have a surface (A_1) horizon of dark-brown clay loam. The subsoil is a dark-brown or brown, heavy clay loam (fig. 10). These soils are on gently sloping to moderately steep sloping ridges and hills in the uplands. They are at elevations of 6,500 to 7,000 feet and have slopes ranging from about 2 to 40 percent. The parent material weathered mainly from the underlying Mancos shale. In most places, however, some wind-laid sediments are mixed with the materials weathered from shale.

The permeability is slow in these soils, and runoff is medium to rapid. The moisture-holding capacity is low,

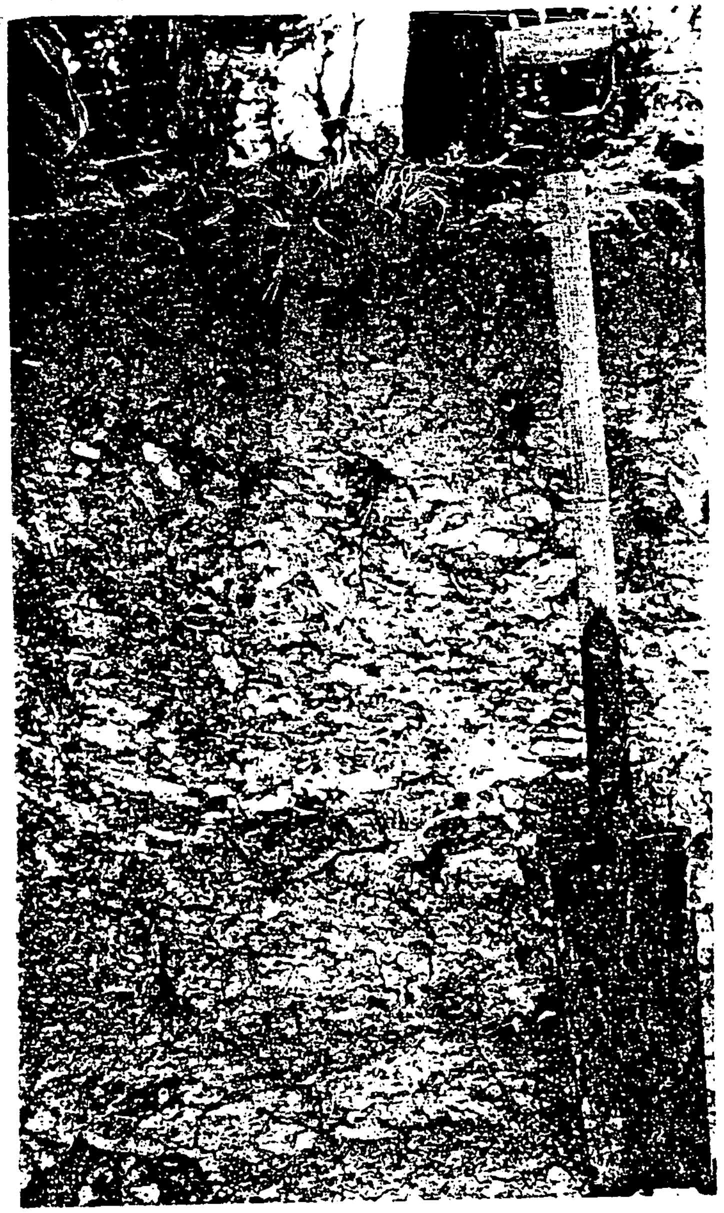

Figure 10.—Profile of Menefee clay loam, 2 to 25 percent slopes.

and the soils are low in inherent fertility. They are moderately susceptible to water erosion.

The Menefee soils are associated with Lockerby, Ucolo, and Hovenweep soils. The vegetation on the Menefee soils consists mainly of pinyon and juniper, but it includes bitterbrush, oakbrush, sagebrush, Indian ricegrass, and junegrass. The soils are occupied almost entirely by woodland used as range.

Menefee clay loam, 2 to 25 percent slopes (MfG).—This soil is extensive in the north-central part of the Area. The following describes a profile about 12.5 miles east of the Monticello School (sec. 12, T. 12 S., R. 25 E.):

A_1 0 to 2 inches, dark-brown (10YR 3/3) clay loam, brown to dark brown (10YR 4/3) when dry; very weak, thin, platy structure that breaks to weak, fine, granular; soft when dry, very friable when moist, slightly sticky and plastic when wet; a few fine roots; strongly calcareous; pH 7.8; abrupt, smooth boundary.

AC 2 to 10 inches, dark-brown (10YR 4/3), heavy clay loam, brown (10YR 5/3) when dry; weak, medium and fine, subangular blocky structure; slightly hard when dry, friable when moist, sticky and plastic when wet; many fine and large roots; few fine pores; strongly calcareous; pH 7.7; clear, wavy boundary.

CD_r 10 to 14 inches, brown (10YR 5/3), heavy clay loam, pale brown (10YR 6/3) when dry; weak, medium and fine, subangular blocky structure; slightly hard when dry, friable when moist, sticky and plastic when wet; many fine and large roots; few fine pores; extremely calcareous; pH 7.7; many fragments of shale; gradual, wavy boundary.

D_r 14 inches +, decomposing, fractured shale.

In many places, directly under the canopy of trees, this soil is covered by a mat of needles and twigs that is 1 to 3 inches thick. The content of organic matter in the surface layer ranges from 2 to 5 percent.

This soil consists entirely of woodland used for range. It is in the Upland Shale (Pinyon-Juniper) range site.

Menefee shaly clay loam, 2 to 25 percent slopes (MfGF).—This soil is on the tops of ridges, where it generally occurs in association with Menefee clay loam, 2 to 25 percent slopes. The surface layer contains many fragments of shale, which increase in number with increasing depth. The soil has a sparse cover of pinyon and juniper. It is in the Upland Shale (Pinyon-Juniper) range site.

Menefee cobbly clay loam, 4 to 40 percent slopes (MfGC).—This cobbly soil is in the northwestern part of the Area. It is associated with Abajo cobbly loam, 2 to 25 percent slopes. In most places the slopes are steep and the soil is covered by a layer of cobblestones and gravel that is 1 to 10 or 12 inches thick. This soil is underlain by decomposing Mancos shale. The vegetation consists chiefly of pinyon, juniper, and oakbrush, and there is an understory of sagebrush and western wheatgrass, Indian ricegrass, squirreltail, and galleta. This soil is in the Upland Shale (Pinyon-Juniper) range site.

Monticello Series

The Monticello series consists of deep, medium-textured, well-drained soils on undulating to rolling uplands. The soils have a surface layer of dark reddish-brown very fine sandy loam. The subsoil has a brighter color and is finer textured than the surface layer, generally between a loam and a sandy clay loam.

These soils are extensive throughout much of the Area and are at elevations of about 5,800 to 7,500 feet. They have slopes ranging from 0 to 10 percent. The parent material was wind-laid deposits derived mostly from sandstone (fig. 11). The low rainfall phases of the soils are in a part of the Area where the climate is somewhat less favorable than that where the other Monticello soils occur.

The Monticello soils are moderately permeable and have slow to medium surface runoff. They are high in available moisture-holding capacity and in inherent fertility. The soils are easy to till, and they absorb moisture readily. They are moderately susceptible to water and wind erosion.

The Monticello soils are associated with Northdale, Montvale, Hovenweep, Abajo, Ackmen, and Vega soils.

The vegetation on the Monticello soils consists of big sagebrush, scattered junipers and pinyons, and a number of kinds of grasses, including western wheatgrass, native bluegrass, and junegrass.

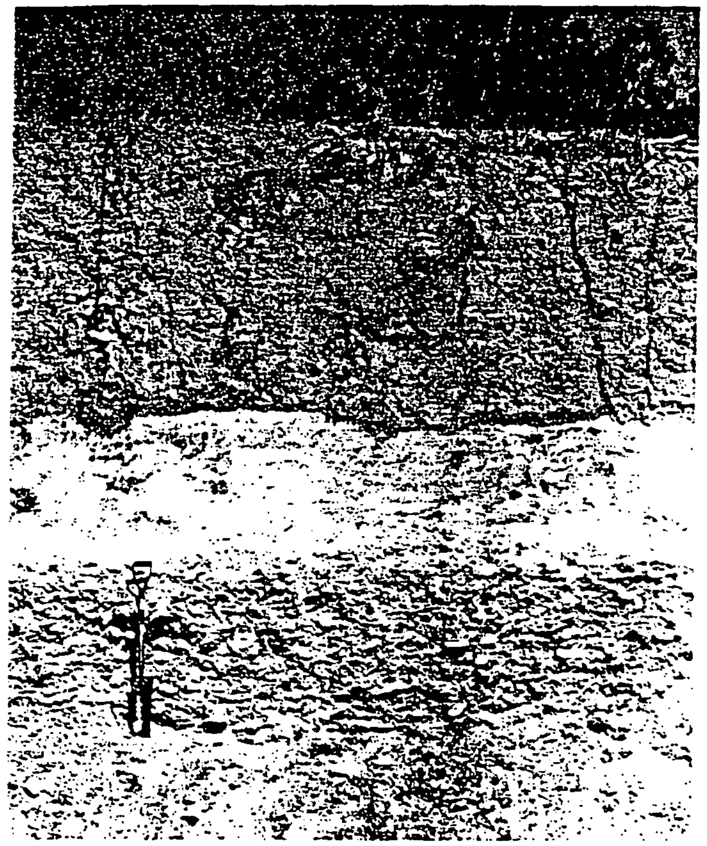

Figure 11.—Deep cut in Monticello very fine sandy loam, 0 to 10 percent slopes. The thick wind-laid deposits from which the soil formed overlie an old, buried soil.

A large acreage of the Monticello soils is used for dry-farming. Winter wheat and pinto beans are the main crops, but cultivated grasses and alfalfa are grown to some extent. Small areas near Monticello, Blanding, and La Sal are irrigated and used for general farm crops and gardens.

Monticello very fine sandy loam, 0 to 10 percent slopes (MnD).—This soil is extensive in the vicinity of Old La Sal. It is also extensive near Monticello and occurs in a belt about 6 miles wide, south of U.S. Highway No. 160 and extending eastward from Monticello to the Colorado line. The following describes a profile in Old La Sal (SE¼ sec. 21, T. 28 S., R. 25 E.):

A_{11} 0 to 3 inches, dark reddish-brown (5YR 3/3) very fine sandy loam, reddish brown (5YR 4/3) when dry; weak, medium, platy structure that breaks to moderate, fine, granular; slightly hard when dry, very friable when moist; many fine roots; noncalcareous; pH 6.8; abrupt, smooth boundary.

A_{12} 3 to 8 inches, dark reddish-brown (5YR 3/3) very fine sandy loam, reddish brown (5YR 4/3) when dry; weak, very thick, platy structure; hard when dry, friable when moist; many fine roots, few very fine pores; noncalcareous; pH 6.9; clear, wavy boundary.

B_{21} 8 to 22 inches, reddish-brown (5YR 4/3), heavy loam; reddish brown (5YR 5/3) when dry; weak to moderate, coarse, prismatic structure that breaks to weak, coarse, subangular blocky; very hard when dry, friable when moist; a few fine roots; many fine pores; noncalcareous; pH 7.2; clear, wavy boundary.

B_{22} 22 to 32 inches, yellowish-red (5YR 4/6), heavy loam, yellowish red (5YR 5/6) when dry; moderate, medium, prismatic structure that breaks to moderate, medium, subangular blocky; very hard when dry, firm when moist; thin clay films in channels and as bridges between the grains of sand; many fine and a few medium pores; few fine roots; noncalcareous; pH 7.3; clear, irregular boundary.

B_3 32 to 45 inches, reddish-brown (5YR 4/4), heavy loam, reddish brown (5YR 5/4) when dry; weak, medium, prismatic structure that breaks to weak, medium, subangular blocky; hard when dry, firm when moist; few fine pores; few fine roots; slightly calcareous and has fine veining of lime; pH 7.9; gradual, wavy boundary.

C 45 to 56 inches, reddish-brown (5YR 4/4) loam, reddish brown (5YR 5/4) when dry; massive; hard when dry, firm when moist; no roots; slightly calcareous; pH 8.1.

The content of organic matter in the surface layer of this soil ranges from about 1.4 percent to 2.3 percent. In many places, at depths ranging from 4 to 6 feet, there is a buried soil (B_{2b}) that differs from the soil above it. The buried soil is finer textured than the overlying soil and contains a strong horizon of lime (C_{ca}).

Monticello very fine sandy loam, 0 to 10 percent slopes, is used for dry-farmed wheat and pinto beans. It is in capability unit IIIc-1 and in the Upland Loam and Upland Loam (Pinyon-Juniper) range sites.

Monticello very fine sandy loam, low rainfall, 2 to 10 percent slopes (MnDL).—This soil is extensive in the northeastern part of the Area. It also occurs near Blanding, and a smaller acreage is near La Sal. The soil is similar to Monticello very fine sandy loam, 0 to 10 percent slopes. Because of somewhat less favorable moisture-temperature relationships, however, its A_1 horizon in many places is slightly thinner, the content of organic matter is slightly lower, and the color of the soil is slightly brighter.

Using this soil for dryfarming is hazardous because of the lack of moisture during years of low rainfall. Nevertheless, the soil is used extensively to grow dry-farmed wheat. Part of the acreage is used for range. The soil is in capability unit IVc-1 and in the Upland Loam and Upland Loam (Pinyon-Juniper) range sites.

Monticello-Hovenweep complex, 2 to 10 percent slopes (MHD).—The soils in this complex are on undulating to rolling uplands about 8 miles southeast of Monticello. They are closely associated with Monticello very fine sandy loam, 0 to 10 percent slopes. The Monticello soil in this complex has a profile similar to that described for Monticello very fine sandy loam, 0 to 10 percent slopes. The Hovenweep soil is similar to Hovenweep loam, 2 to 6 percent slopes. It overlies decomposing Mancos shale.

The soils of this complex are used to grow dry-farmed wheat and pinto beans. They are in capability unit IIIc-1 and in the Upland Loam and Upland Loam (Pinyon-Juniper) range sites.

Monticello-Hovenweep complex, low rainfall, 2 to 10 percent slopes (MHDL).—The soils of this complex are on undulating to rolling uplands about 8 miles east of Monticello. They are closely associated with Monticello very fine sandy loam, low rainfall, 2 to 10 percent slopes, and with Northdale loam, low rainfall, 0 to 6 percent slopes. The soils are used for dry-farmed wheat and for range. They are in capability unit IVc-1 and in the Upland Loam and Upland Loam (Pinyon-Juniper) range sites.

Montvale Series

The Montvale series consists of shallow or very shallow, very rocky, medium-textured, well-drained soils that overlie sandstone bedrock. The surface (A_1) horizon is dark reddish-brown very stony very fine sandy loam or loam. The subsoil is a dark reddish-brown very stony loam. The soils are on undulating to rolling uplands that, in many places, are adjacent to steep canyon breaks. They are at elevations of 5,800 to 7,500 feet and have slopes ranging from about 2 to 25 percent. The parent material weathered mainly from the underlying Dakota sandstone, but consisted partly of wind-deposited materials.

Permeability is moderate in these soils, and runoff is medium. The available moisture-holding capacity is low, and inherent fertility is low. The soils are moderately susceptible to water erosion.

In most places the Montvale soils are associated with Northdale soils or with Sandstone rockland. In a few places they occur in association with Monticello soils.

The vegetation on the Montvale soils consists of pinyon, juniper, black sagebrush, big sagebrush, snakeweed, western wheatgrass, native bluegrass, and junegrass. The Montvale soils are used for range or as woodland used for range. Only one soil of this series is mapped in the Area.

Montvale very rocky very fine sandy loam, 2 to 25 percent slopes (MvG).—This soil is widely distributed throughout a large part of the Area. The following describes a profile near Summit Point (about 0.4 mile west of the southeastern corner of sec. 9, T. 33 S., R. 26 E.):

A_1 0 to 3 inches, dark reddish-brown (5YR 3/3) very stony loam to very fine sandy loam, brown (7.5YR 5/4) when dry; weak, thick, platy structure that breaks to weak, very fine, granular; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; few fine roots; noncalcareous; pH 7.8; abrupt, smooth boundary.

B_1 3 to 7 inches, dark reddish-brown (5YR 3/3) very stony loam, reddish brown (5YR 4/3) when dry; weak, thick, platy structure that breaks to weak, medium, angular blocky; hard when dry, firm when moist, slightly sticky and slightly plastic when wet; many fine roots; few fine pores; noncalcareous; pH 7.7; clear, wavy boundary.

B_2 7 to 13 inches, reddish-brown (5YR 4/3) very stony loam, reddish brown (5YR 5/3) when dry; weak, medium, prismatic structure that breaks to weak, subangular blocky; thin, patchy clay films in channels; very hard when dry, firm when moist, slightly sticky and slightly plastic when wet; noncalcareous; few fine, medium, and large roots; many fine pores; pH 7.6; gradual, wavy boundary.

B_{3ca} 13 to 18 inches, reddish-brown (5YR 4/4) very stony loam, reddish brown (5YR 4/4) when dry; weak, coarse, prismatic structure that breaks to moderate, medium, subangular blocky; thin, patchy clay films in channels; very hard when dry, very firm when moist, sticky and plastic when wet; many fine roots; many fine pores; very strongly calcareous; pH 8.0; gradual, wavy boundary.

D_r 18 inches +, sandstone, partially decomposing and fractured, that grades to hard parent rock.

The number of angular fragments of sandstone in this soil varies widely from place to place. The number also varies according to the depth in the profile. The fragments are generally more numerous on the surface than in the subsoil. From 15 to 25 percent of the total acreage consists of exposed bare rock or of areas in which the soil is less than 8 inches thick. The texture of the surface layer ranges from fine sandy loam to loam, and the content of organic matter is 2.1 percent.

This soil is in the Upland Stony Hills (Pinyon-Juniper) range site.

Northdale Series

The Northdale series consists of moderately deep, medium textured and moderately fine textured, well-drained soils on undulating to rolling uplands. The surface layer is dark reddish-brown loam. The subsoil is similar to the surface layer in color but is generally finer textured, ranging from heavy loam to light clay loam. Sandstone and shale bedrock is at a depth of 20 to 36 inches.

The Northdale soils are extensive throughout a large part of the Area and are at elevations of about 5,800 to 7,500 feet. They have slopes ranging from about 2 to 10 percent. The parent material was derived from wind-laid deposits and from the underlying sandstone and shale.

The Northdale soils are moderately permeable and have slow to rapid surface runoff, depending on the slope. They absorb moisture readily and have moderate moisture-holding capacity. Their inherent fertility is high to moderately high. These soils are moderately to highly susceptible to water and wind erosion.

The Northdale soils are closely associated with Monticello, Montvale, Abajo, and Hovenweep soils. Ackmen and Vega soils are in entrenched positions within the same association, but they are of minor extent.

The vegetation on the Northdale soils is mainly western wheatgrass, native bluegrass, junegrass, big sagebrush, pinyon, and juniper. These soils are used extensively for dryfarming and for range.

Northdale loam, 0 to 6 percent slopes (NIC).—This soil is extensive near Monticello. It also occurs in a belt about 6 miles wide, extending eastward from Monticello and south of U.S. Highway No. 160 to the Colorado line. This soil is closely associated with Monticello very fine sandy loam, 0 to 10 percent slopes. The following describes a profile 1.5 miles east of the Montezuma Weather Station (185 feet north and 250 feet east of the southwestern corner of SE¼ sec. 22, T. 35 S., R. 26 E.):

A_1 0 to 3 inches, dark reddish-brown (5YR 3/3) loam, reddish brown (5YR 5/4) when dry; weak, medium and thick, platy structure that breaks to weak, very fine, granular; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; few fine roots; noncalcareous; pH 7.9; abrupt, smooth boundary.

B_1 3 to 8 inches, dark reddish-brown (5YR 3/4) loam, reddish brown (5YR 4/3) when dry; weak, medium, prismatic structure that breaks to weak, medium, subangular blocky; hard when dry, firm when moist, slightly sticky and slightly plastic when wet; many fine roots; few fine pores; noncalcareous; pH 7.6; clear, wavy boundary.

B_2 8 to 19 inches, dark reddish-brown (5YR 3/4), heavy loam, reddish brown (5YR 4/4) when dry; weak, medium, prismatic structure that breaks to moderate, fine, subangular blocky; thin, patchy clay films in channels and as bridges between sand grains; hard when dry, firm when moist, slightly sticky and plastic when wet; many fine roots; few fine pores; noncalcareous; pH 7.5; clear, wavy boundary.

B_{3ca} 19 to 28 inches, reddish-brown (5YR 5/4), light clay loam, pink (5YR 7/3) when dry; weak, medium, subangular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; few fine roots; few fine pores; very strongly calcareous; pH 8.2; clear, wavy boundary.

C_{ca} 28 to 31 inches, light reddish-brown (5YR 6/4) clay loam, pink (5YR 7/3) when dry; weak, medium, subangular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; a few fine roots; a few fine pores; very strongly calcareous; pH 8.3; 0 to 6 inches thick.

D_r 31 inches +, decomposing, fractured sandstone and shale bedrock.

This soil is used extensively for dry-farmed wheat and pinto beans. It is in capability unit IIIc–2 and in the Upland Loam and Upland Loam (Pinyon-Juniper) range sites.

Northdale loam, 6 to 10 percent slopes (NlD).—This soil is similar to Northdale loam, 0 to 6 percent slopes, but it is about 6 inches shallower and has a slightly thinner surface (A_1) horizon. The soil is used mainly for dry-farmed wheat and for range. It is in capability unit IVe–1 and in the Upland Loam and Upland Loam (Pinyon-Juniper) range sites.

Northdale loam, low rainfall, 0 to 6 percent slopes (NlCL).—This soil is similar to Northdale loam, 0 to 6 percent slopes. Because moisture has been somewhat less favorable, however, the surface (A_1) horizon is slightly thinner and brighter in color (stronger chroma) and contains slightly less organic matter. The soil is extensive in the north-central and northeastern parts of the Area.

Using this soil for dryfarming is hazardous because of the lack of moisture during years of low rainfall. Nevertheless, the soil is used for growing dryfarmed wheat. Part of the acreage is used for range. This soil is in capability unit IVc–3 and in the Upland Loam and Upland Loam (Pinyon-Juniper) range sites.

Northdale loam, low rainfall, 6 to 10 percent slopes (NlDL).—This soil is similar to Northdale loam, 0 to 6 percent slopes. It is about 6 inches shallower, however, and has steeper slopes and a somewhat thinner surface layer.

This soil is best kept in range. It is in the Upland Loam and Upland Loam (Pinyon-Juniper) range sites.

Northdale loam, 2 to 10 percent slopes, severely eroded (NlD3).—This soil is inextensive. Because of severe gullying, it is suited only to limited use for range. The soil is in the Upland Loam range site.

Pack Series

The Pack series consists of deep, medium-textured, imperfectly drained soils that are noncalcareous. The soils are in narrow, entrenched drainageways. In many places these soils are dissected by the channels of intermittent streams, which have lowered the water table and improved the drainage. The surface horizon is black to very dark gray silt loam or loam. It is underlain by very dark gray, heavy loam or light clay loam. The soils occur only in the Old La Sal part of the Area at elevations of from 7,000 to 7,500 feet. They have slopes ranging from about 0 to 6 percent. Their parent material was alluvium derived mainly from intrusive igneous rocks, but it included some materials from sandstone.

These soils have moderate permeability, slow runoff, and high available moisture-holding capacity. They are moderately susceptible to water erosion. The soils are easily tilled, absorb moisture readily, and have high inherent fertility.

The Pack soils are associated with Abajo, Monticello, and Northdale soils. The vegetation on the Pack soils consists of western wheatgrass, oakbrush, rabbitbrush, big sagebrush, willow, and Kentucky bluegrass.

The Pack soils are mainly in irrigated meadow that is used for hay and pasture. A few small areas are used for gardens.

Pack silt loam, 2 to 6 percent slopes (PsC).—The following describes a profile near La Sal Creek (NE¼ sec. 27, T. 28 S., R. 25 E.):

A_{11} 0 to 4 inches, black (10YR 2/1) silt loam, dark gray (10YR 4/1) when dry; weak, medium, platy structure that breaks to moderate, medium, granular; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few fine roots; very few fine pores; noncalcareous; pH 7.6; abrupt, smooth boundary:

A_{12} 4 to 25 inches, black (10YR 2/1) silt loam, dark gray (10YR 4/1) when dry; weak, medium and fine, granular structure; hard when dry, friable when moist, slightly sticky and plastic when wet; few fine roots; few fine pores; noncalcareous; pH 7.6; clear, wavy boundary.

AC 25 to 36 inches, black (10YR 2/1), light clay loam, gray (10YR 4/1) when dry; massive; very hard when dry, firm when moist, sticky and plastic when wet; few fine roots; few fine pores; noncalcareous; pH 7.6; clear, wavy boundary.

C_g 36 to 60 inches, very dark gray (10YR 3/1), heavy loam, gray (10YR 5/1) when dry; many, fine, distinct mottles of reddish yellow (5YR 6/6); massive; very hard when dry, firm when moist, slightly sticky and slightly plastic when wet; very few fine roots; no pores; noncalcareous; pH about 7.6.

The surface layer of this soil ranges in color from black to very dark gray, and in texture, from silt loam to loam. The dark color of the soil and the reddish-yellow iron mottling in the C horizon reflect the imperfect drainage. Depth to mottling ranges from about 34 to 55 inches. This soil is in capability unit IIIc–3 and in the Upland Loam range site.

Pack silt loam, moderately deep water table, 0 to 3 percent slopes (PsBW).—This soil is closely associated with Pack silt loam, 2 to 6 percent slopes, but it is in somewhat lower positions. The two soils are similar, but this soil is more nearly level and has a moderately deep water table. As a result, it has more pronounced mottling at a depth between 20 and 40 inches than Pack silt loam, 2 to 6 percent slopes. This soil lacks the dissecting channels of intermittent streams that are typical of the series.

This soil is used for meadow hay and for pasture. It is in the Semiwet Meadow range site.

Pack cobbly silt loam and silt loam, 2 to 6 percent slopes (PsCC).—These undifferentiated soils are along the flood plains of La Sal Creek. The cobbly material was washed into the area from the La Sal Mountains and from side drainageways. The soils are suited only to range. They are in the Upland Loam range site.

Sandstone Rockland

Sandstone rockland, sloping (SdD).—This miscellaneous land type consists of bare outcrops of Dakota sandstone that are most extensive in the northeastern part of the Area. It is closely associated with Montvale soils and with Sandstone rockland, steep. This land type is in the Upland Stony Hills (Pinyon-Juniper) range site.

Sandstone rockland, steep (SdE).—This miscellaneous land type consists mainly of the steep walls of canyons. The sides of the canyons consist of a series of narrow terraces that have nearly vertical walls of sandstone. On these narrow terraces a thin mantle of stony soil supports a sparse growth of juniper, pinyon, big sagebrush, black sagebrush, bullgrass, Indian ricegrass, and native bluegrass.

This land type is most extensive in the larger canyons, such as Montezuma Canyon and its branches. It is used to a limited extent for grazing, and it is in the Upland Stony Hills (Pinyon-Juniper) range site.

Scorup Series

The Scorup series consists of moderately deep to deep, medium-textured well-drained soils that overlie cemented layers of lime. The surface horizon is a dark reddish-brown very fine sandy loam. The subsoil is dark reddish-brown to reddish-brown loam. Pebbles and cobblestones occur in varying amounts in the lower horizons. Soluble salts increase in the lower C horizon above the indurated hardpan.

Scorup soils occur mainly on uplands near La Sal. They are on old alluvial fans and on stream terraces at elevations ranging from 6,200 to 7,000 feet. A few small areas are in the general vicinity of Blanding. The soils have slopes ranging from about 2 to 25 percent. The parent material was derived from light-colored, fine-grained igneous rocks.

Above the cemented layer of lime, these soils are moderately permeable. Runoff is slow to medium, and the available moisture-holding capacity is moderate. The soils are high in fertility. They are moderately susceptible to water and wind erosion.

The Scorup soils are associated with Monticello, Northdale, and Ackmen soils. The vegetation on the Scorup soils near La Sal is mainly big sagebrush, but there is some native bluegrass, western wheatgrass, squirreltail, and pricklypear.

These soils are used mainly for grazing. A limited acreage near La Sal is used for irrigated farming.

Scorup very fine sandy loam, 2 to 6 percent slopes (SnC).—The following describes a profile about 1.5 miles west of the livestock store at La Sal (NW¼ sec. 4, T. 29 S., R. 24 E.):

A_{11} 0 to 4 inches, dark reddish-brown (5YR 3/3) very fine sandy loam, reddish brown (5YR 4/3) when dry; weak, thick, platy structure that breaks readily to weak, fine, granular; soft when dry, very friable when moist, nonsticky and nonplastic when wet; many fine roots; few fine pores; noncalcareous; pH about 8.5; abrupt, smooth boundary.

A_{12} 4 to 9 inches, dark reddish-brown (5YR 3/3), heavy very fine sandy loam, reddish brown (5YR 4/3) when dry; very weak, coarse, subangular blocky structure that breaks readily to fine, subangular blocky and fine, granular; slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; many fine roots; few fine pores; noncalcareous; pH about 8.1; clear, wavy boundary.

B_1 9 to 15 inches, dark reddish-brown (5YR 3/4) loam, reddish brown (5YR 4/4) when dry; weak, coarse, subangular blocky structure that breaks to moderate, medium, subangular blocky; hard when dry, friable when moist, slightly plastic and nonsticky when wet; many roots; many fine and medium pores; noncalcareous; pH about 7.9; clear, wavy boundary.

B_2 15 to 22 inches, dark reddish-brown (5YR 3/4) loam, reddish brown (5YR 6/4) when dry; weak, coarse, subangular blocky structure that breaks to weak, medium, subangular blocky; few thin, patchy clay films in pores and in root channels; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; many fine and medium pores; many fine roots; slightly calcareous; pH about 8.0; scattered pebbles and cobblestones; gradual, wavy boundary.

B_{3ca} 22 to 31 inches, reddish-brown (5YR 4/4), light clay loam, light reddish brown (5YR 6/3) when dry; weak, coarse, subangular blocky structure that breaks to weak, medium, subangular blocky; very hard when dry, firm when moist, plastic and slightly sticky when wet; many fine roots; many fine pores; strongly calcareous; pH about 7.9; scattered pebbles; clear, wavy boundary.

C_{ca} 31 to 44 inches, pink (5YR 7/3) loam, pinkish white (5YR 8/2) when dry; massive; weakly cemented; no roots; extemely calcareous, 50 percent $CaCO_3$; pH about 8.2; scattered pebbles and cobblestones; clear, wavy boundary.

C_{cam} 44 to 56 inches, pinkish-white (5YR 8/2), both moist and dry, indurated lime pan that has pebbles and cobblestones in the matrix; 0 to 15 inches thick.

C 56 to 60 inches, pink (5YR 7/3) very cobbly loam, pink (5YR 7/3) when dry; massive; much lower in content of lime than horizon immediately above.

The texture of the surface layer ranges from very fine sandy loam to loam. The lime horizon varies in thickness, in degree of cementation, and in depth from the surface.

This soil absorbs moisture readily and is easily tilled.

Small areas of Scorup cobbly very fine sandy loam, 2 to 25 percent slopes, have been mapped with this soil. These areas were not large enough to map separately.

Scorup very fine sandy loam, 2 to 6 percent slopes, is of limited extent. Much of the acreage has been seeded to suitable range grasses, and a small acreage is used for irrigated crops. The soil is in capability unit IVc–1 and in the Upland Loam and Upland Loam (Pinyon-Juniper) range sites.

Scorup cobbly very fine sandy loam, 2 to 25 percent slopes (SnGC).—Except that it contains many more pebbles and cobblestones throughout, this soil is similar to Scorup very fine sandy loam, 2 to 6 percent slopes. The soil is suited only to range. It is in the Upland Loam and Upland Loam (Pinyon-Juniper) range sites.

Shay Series

The Shay series consists of deep, fine-textured, imperfectly drained soils formed in alluvium. Normally, the soils have a surface layer of very dark brown clay loam and a subsoil of very dark gray to black silty clay (fig. 12). The soils have slight accumulations of soluble salts below a depth of 30 inches. They are in the western part of the Area, north and south of Monticello. The soils are at elevations of about 6,500 to 7,100 feet. They are inextensive and occur in narrow, slightly entrenched drainageways. In many places the soils are dissected by the channels of intermittent streams, which have lowered the water table and improved the drainage. The parent material was derived mainly from dark-colored shale. Slopes range from 0 to 3 percent.

These soils have very slow permeability and slow runoff. They are moderately susceptible to water erosion. The moisture-holding capacity and inherent fertility are high.

The Shay soils are adjacent to Montvale, Abajo, and Monticello soils. They are similar to the Vega, Ucolo, and Pack soils.

Figure 12.—Profile of Shay clay loam, 0 to 3 percent slopes. This soil has a blocky structure and vertical cracking.

The vegetation on the Shay soils consists of western wheatgrass, big sagebrush, and rabbitbrush. The soils are used mainly for irrigated pasture or for hay and range.

Shay clay loam, 0 to 3 percent slopes (ShB).—The following describes a profile about 6 miles north and 0.5 mile east of Monticello:

A_p 0 to 3 inches, very dark brown (10YR 2/2) clay loam, dark grayish brown (10YR 4/2) when dry; weak, thin, platy structure that breaks to weak, fine, granular; hard when dry, friable when moist, sticky and plastic when wet; few fine roots; few fine pores; moderately calcareous; pH about 7.6; content of organic matter 3.7 percent; clear, smooth boundary.

AC 3 to 12 inches, very dark brown (10YR 2/2), light silty clay, dark grayish brown (10YR 4/2) when dry; weak, coarse, prismatic structure that breaks to weak, subangular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; many fine roots; many fine and a few large pores; moderately calcareous; pH about 7.8; content of organic matter, 2.7 percent; clear, wavy boundary.

C_{1g} 12 to 30 inches, black (10YR 2/1) silty clay, dark gray (10YR 4/1) when dry; weak, prismatic structure that breaks to weak, subangular blocky; very hard when dry, firm when moist, very sticky and plastic when wet; many fine roots; few fine pores; moderately calcareous; pH about 7.9; clear, wavy boundary.

C_{2g} 30 to 60 inches, very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) when dry; moderate, medium, prismatic structure that breaks to moderate, medium and fine, subangular blocky; very hard when dry, firm when moist, very sticky and plastic when wet; no roots or pores; few, fine, distinct, reddish-brown (5YR 5/4) mottlings; slightly calcareous; pH about 7.6.

The texture of the surface layer ranges from clay loam to silty clay loam, but in places it is light silty clay. The color of the moist surface layer ranges from dark grayish brown to very dark brown. The content of organic matter in the surface layer ranges from about 3 to 4 percent. In places the clay loam or silty clay loam extends to a depth of 20 inches. Some textural stratification is common, but layers of clay and silty clay predominate.

This soil is difficult to till. Except when it is dry and cracked, it absorbs moisture slowly. The soil is better suited to grass than to other crops. It is in capability unit IVc-2 and in the Upland Clay range site.

Shay clay loam, 0 to 3 percent slopes, severely eroded (ShB3).—This severely gullied, eroded soil is closely associated with Shay clay loam, 0 to 3 percent slopes. The profiles of the two soils are similar, but this soil has better drainage because of the gullying. This soil is used for range. It is in the Upland Clay range site.

Ucolo Series

The Ucolo series consists of deep, moderately well drained soils formed in alluvium. The surface soil is dark grayish-brown silty clay loam that is underlain by dark grayish-brown silty clay. Soluble salts increase with increasing depth in these soils. Slight accumulations occur at a depth of 10 to 20 inches and increase in amount to a depth of about 53 inches. In most places the soils are in slight depressions adjacent to intermittent drainageways. They are at elevations ranging from 6,500 to 6,800 feet and have slopes ranging from about 0 to 10 percent.

Permeability is slow to very slow in these soils, and runoff is medium. The moisture-holding capacity is high. The soils are moderately susceptible to water and wind erosion. Inherent fertility is moderately high.

The Ucolo soils are mainly in the north-central part of the Area, where they are associated with the Lockerby and Hovenweep soils. The vegetation on the Ucolo soils consists mainly of big sagebrush, black sagebrush, and western wheatgrass, but there are local areas of greasewood. The Ucolo soils are used chiefly for range. They are also used to a limited extent to grow dry-farmed wheat.

Ucolo silty clay loam, 0 to 3 percent slopes (UyB).—The following describes a profile about 2.5 miles north of U.S. Highway No. 160 along the West Summit Point road:

A_{11} 0 to 2 inches, dark grayish-brown (10YR 4/2), light silty clay loam, grayish brown (10YR 5/2) when dry; weak, medium, platy crust that breaks easily to weak, fine, granular structure; slightly hard when dry, friable when moist; strongly calcareous; pH about 8.2; abrupt, smooth boundary.

A_{12} 2 to 10 inches, very dark grayish-brown to dark grayish-brown (10YR 4/2) silty clay loam, grayish brown (10YR 5/2) when dry; weak, thick, platy structure that breaks to thin, platy; slightly hard when dry, friable when moist; strongly calcareous; pH about 8.2; gradual, smooth boundary.

C_1 10 to 30 inches, dark grayish-brown (10YR 4/2) silty clay; grayish brown (10YR 5/2) when dry; very weak, medium, prismatic structure that breaks to weak, subangular blocky; very hard when dry, firm when moist; many fine roots; fine pores common; very strongly calcareous; pH about 8.4.

C_2 30 to 53 inches, dark grayish-brown (10YR 4/2) clay, grayish brown (10YR 5/2) when dry; massive; very hard when dry, very firm when moist; many fine, decaying roots at a depth of 30 to 42 inches; very strongly calcareous; veining of salt and gypsum; salts about 1.5 percent; pH about 8.3.

C 53 to 72 inches, grayish-brown (2.5Y 5/2) clay, light brownish gray (2.5Y 6/2) when dry; massive; extremely hard when dry, very firm when moist; extremely calcareous and has fine veins of lime; soluble salts about 1 percent; pH about 8.4.

The content of salt varies considerably in this soil, both in concentration and in location within the profile. In most places there are fine veins of gypsum in the deeper horizons. In places shale is at a depth between 60 and 72 inches.

This soil is difficult to till and absorbs moisture slowly. It is better suited to grass than to other crops. The soil is in capability unit IVc-2 and in the Upland Clay range site.

Ucolo silty clay loam, 2 to 10 percent slopes, moderately eroded (UyD2).—This is the most extensive soil of the Ucolo series. It differs from Ucolo silty clay loam, 0 to 3 percent slopes, in having a thinner surface layer and a few deep gullies. This soil is best suited to grass. It is in the Upland Clay range site.

Ucolo silty clay loam, 0 to 3 percent slopes, severely eroded (UyB3).—This soil has been severely eroded and has been cut by a network of gullies. The surface layer has been almost entirely removed. It is in the Upland Clay range site.

Vega Series

The Vega series consists of deep, moderately fine textured, moderately well drained soils formed in alluvium. Normally, the surface layer is very dark grayish-brown clay loam that overlies dark-brown clay loam or light clay loam. Accumulations of soluble salts occur in the C horizons of these soils. They are highest at a depth between 15 and 30 inches. The soils are mainly along narrow, entrenched valleys of intermittent streams. They are in the western part of the Area at elevations of about 5,800 to 7,000 feet. The topography is smooth, and slopes range from about 0 to 6 percent. The alluvium in which the soils formed was derived from a mixture of igneous and sedimentary rocks.

Permeability is slow in these soils, and runoff is slow to medium. The available moisture-holding capacity is high. These soils are moderately susceptible to water erosion. Inherent fertility is high.

The Vega soils are associated with Abajo and Monticello soils. The vegetation on the Vega soils is big sagebrush, rabbitbrush, oakbrush, western wheatgrass, and native bluegrass.

Some areas of the Vega soils are dry-farmed. Other small tracts are used for general irrigated farming. Most of the acreage that is eroded is used for range.

Vega clay loam, 0 to 6 percent slopes (VcC).—The following describes a profile about 2.2 miles east of Monticello:

A_1 0 to 4 inches, very dark grayish-brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) when dry; weak, medium, platy structure that breaks to moderate, medium, granular; slightly hard when dry, friable when moist; moderately calcareous; pH about 7.7.

C_1 4 to 15 inches, dark-brown (10YR 3/3) clay loam, dark grayish brown (10YR 4/2) when dry; very weak, medium, prismatic structure; very hard when dry; firm when moist; many fine roots; many fine pores; moderately calcareous; pH about 7.6.

C_2 15 to 30 inches, dark-brown (10YR 3/3), light clay loam, dark grayish brown (10YR 4/2) when dry; massive; hard when dry, friable when moist; slightly calcareous; few large roots; a few fine pores; pH about 7.5.

C_3 30 to 40 inches, dark-brown (7.5YR 3/2) clay loam, dark brown (7.5YR 4/2) when dry; massive to weak, medium, prismatic structure; hard when dry, friable when moist; slightly calcareous; pH about 7.7.

C_4 40 to 52 inches, very dark grayish-brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) when dry; massive to weak, medium, prismatic structure; hard when dry, firm when moist; moderately calcareous; strong veining of gypsum; pH about 7.9.

The color of the moist surface soil ranges from very dark grayish brown to very dark brown or dark brown, and the content of organic matter, from about 2.5 to 3.5 percent. Some textural stratification is common, but layers of clay loam or silty clay loam predominate.

This soil is easily tilled and absorbs moisture readily. It is high in fertility. The soil is in capability unit IIIc-3 and in the Upland Loam range site.

Vega clay loam, 0 to 6 percent slopes, moderately eroded (VcC2).—This soil is similar to Vega clay loam, 0 to 6 percent slopes, except that it generally occurs in areas where water erosion has formed deep gullies. It is better suited to grass than to other crops and is in the Upland Loam range site.

Vega clay loam, 0 to 3 percent slopes, severely eroded (VcB3).—This soil has been cut by a network of deep gullies. It has little value, even as range. The soil is in the Upland Loam range site.

Vega clay loam, moderately deep water table, 0 to 3 percent slopes (VcBW).—This soil receives drainage water from higher lying areas. Except for a few, faint, reddish-brown mottles in the deeper part of the substratum, it is similar to Vega clay loam, 0 to 3 percent slopes, severely eroded. It is better suited to grass than to other crops and is in the Semiwet Meadow range site.

Formation, Classification, and Morphology of Soils

In this section the factors that have affected the formation of the soils are described. Also discussed are the classification and morphology of the soils.

Factors of Soil Formation

Soils differ from one another because of variations in the factors that govern their formation. These factors are (1) climate; (2) vegetation and other living organisms; (3) topography, or landform; (4) parent materials; and (5) time.

Regional differences in soils usually reflect differences in climate and vegetation, but local differences are more often caused by topography, parent materials, and time.

For example, all the soils of the San Juan Area are similar in some ways because they formed under similar climatic conditions and under essentially the same type of vegetation. All of the soils are leached to a limited extent, but they are not strongly weathered. Most of them are low or moderately low in organic matter. Such features reflect the influences of climate and vegetation. Furthermore, the sequence of horizons in profiles of soils in smooth to undulating uplands is the same throughout the Area, though the degree of expression of those horizons varies and the horizons also vary in thickness.

The degree of horizonation may reflect the influence of one or more of the factors of parent materials, topography, and time. The soils of swales and drainageways illustrate the local effects of time in the formation of soils. Because such soils are in valleys, they have received more water than the soils of uplands, and they have also received fresh sediments at irregular intervals. The time for horizon differentiation to have taken place in these soils has, therefore, been very short, and the profiles lack most of the horizons common to soils that are older. Because fresh organic matter has been added, such soils have a darkened surface layer, or the beginnings of an A_1 horizon. Little else has happened to them to give rise to horizons.

Soils that have formed in materials weathered from rocks that have remained in place tend to have more distinct horizons than soils formed in materials transported from other places, whether on uplands or in other positions in the landscape. The most distinct horizons, therefore, are generally in the soils of greater age; that is, in soils that have been subject to horizon differentiation for the longest intervals of time. This holds true, especially for soils formed from parent materials of medium texture and mixed mineralogy, where climate, vegetation, and topography remain substantially the same.

In the San Juan Area, the soils that formed on the high, old, cobbly alluvial fans bordering the Abajo and La Sal Mountains have a distinct B horizon of clay that is lacking in soils formed in other parent materials. The topographic positions of the fans indicate that the fans are the oldest land surfaces in the survey area. Presumably, the interval for horizon differentiation in soils on such surfaces has, therefore, been longer than on other surfaces in the San Juan Area.

Climate

The climate, or the amount of heat and moisture received, has a marked influence on the kind of soil that forms. This is because heat and moisture strongly influence the amount and kind of vegetation, the rate that organic matter decomposes, the rate at which minerals weather, and the removal or accumulation of materials in the different soil horizons.

The climate of the San Juan Area ranges from semiarid to dry subhumid. The extreme southwestern part, beginning about 6 miles south of Blanding, is the most arid part of the Area.

The climate is characterized by cold winters and relatively mild summers. The average annual precipitation is about 16.26 inches at Monticello and 12.77 inches at Blanding. The highest rainfall occurs in August, September, and October, and the lowest, during May and June. Much of the precipitation in summer falls as showers, and the moisture is rapidly evaporated or transpired.

Recorded frost-free periods vary greatly throughout the Area. They range from 107 days at Northdale, just over the State line in Colorado, to 147 days at Blanding.

Under the prevailing climate, soils of the San Juan Area would be expected to be leached of their carbonates to some extent. Carbonates originally present in the surface layer should have been moved downward in the profile, providing that initial levels were not exceedingly high and that the regolith was permeable. Such downward leaching of carbonates has occurred in the soils of the Monticello, Northdale, and Blanding series. The A and the upper B horizons of these soils are free of carbonates, but the soils of all three series have accumulations of carbonates within 2 or 3 feet of the surface.

Some of the parent materials in the survey area are especially high in lime, or calcium carbonate. Leaching has also occurred in these soils to some extent, but the removal of carbonates from the surface horizon has not yet been accomplished. The occurrence of a higher concentration of carbonates at a depth somewhere between 12 and 30 inches and the relationships of that horizon to others in the profile indicate that some transfer of carbonates has taken place. It may have been as much as in soils formed in regoliths initially lower in lime.

As a general rule, carbonates must be removed from the soil before silicate clay minerals can be moved downward from the A into the B horizon. Because the leaching of carbonates from the soils is not well advanced in the San Juan Area, as yet there has been little translocation of clay in the profiles. For the most part, accumulations of clay in the B horizon are lacking or are slight.

The annual rainfall is lower in the southwestern part of the Area than it is in the northern and eastern parts. In the part that has the lowest rainfall, the Blanding soil, a Sierozem, has formed from eolian sediments. Farther north and east, the Monticello soils of the Brown great soil group have formed in the same kind of eolian sediments. In this Area the soils of both the Blanding and Monticello series are very fine sandy loams.

The Blanding soil is in areas where the rainfall is lower than it is in the areas where the Monticello soils occur, and this is reflected in these soils in two ways. Data for calcium carbonate equivalent, by individual horizons, for these two soil types show that the Monticello very fine sandy loams are leached of lime to a depth of 18 to 30 inches. The Blanding very fine sandy loam, on the other hand, is leached of lime to a depth of 16 inches or less. The levels of organic matter in the A_1 horizon are also related to the amount of rainfall. The A_1 horizon of the Blanding soil contains 0.89 percent of organic matter, and the corresponding horizon of the Monticello soils contains 1.82 percent.

Except that the B_2 horizon of the Monticello soils has a slightly higher chroma, differences in rainfall are not reflected in profile differences between the modal and low rainfall phases of the Northdale and Monticello soils.

Persistence of the present climate or of a similar one over a long period of time is indicated for the San Juan Area by the nature of buried soil profiles. Buried soils commonly lie below the eolian mantle in which Monticello and Blanding soils have formed. Less commonly, they underlie other kinds of sediments. Like the modern soils, the buried soils appear to be members of the Brown soil group. Many are intermediate in degree of horizonation between the soils of the Monticello and the Abajo series. The similarities between the buried and modern soils suggest that the climate of the Area has long been much as it is now.

Further evidence of probable past climatic conditions can be found from observing a deep cut in which two buried soil profiles were noted. The deeper of the two buried soils was formed in cobbly alluvium and is much like the Abajo soils as they occur on the present land surface farther west. Above this buried soil is a mantle of eolian sediments in which a second Brown soil profile has formed. This second buried soil is also covered by a mantle of eolian sediments in which a third profile has formed, this last being a profile of a Monticello very fine sandy loam.

The similarities among the three profiles in this one vertical section indicate that the processes of soil formation have been substantially the same during three different intervals. The buried soils in this one exposure have more distinct horizons than most of the modern soils in the survey area. This holds true generally for the buried soils, though it is not true of all of them.

The degree of horizonation is commonly greater in buried soils than in modern ones. But the characteristics of horizons and their sequence in the profile are the same, regardless of whether the soil is now at the surface or covered by a mantle of some kind. Differences in degree of horizonation could be caused by a greater interval of time during which horizons could develop when the soils, now buried, were on the surface. The indications are that during two intervals in the geologic past the processes of soil formation were essentially the same as they are at present, and this lends support to the inference that climate has remained much as it is now for a long period of time.

Vegetation

The available information about the vegetation in the Area indicates that there were local differences in the original plant cover. The principal differences seem to have been in the relative proportions of the various kinds of plants and in the density of the stands. In arriving at estimates of the original cover, the available information on vegetation has been considered in relation to the nature and distribution of the soils.

The original vegetation for a large part of the survey area seems to have been a stand of pinyon and juniper with an understory of grasses, forbs, and shrubs. Indications are that the stand of trees ranged from open in some places to dense in others, but that in most places it was open.

The original vegetation in the southern part of the Area, where the climate is distinctly semiarid, appears to have differed somewhat from that farther north and east. Vegetation on the shallow, stony Mellenthin soil, in the southern part of the Area, consisted of a stand of juniper, an occasional pinyon, and a sparse understory of grasses, forbs, and shrubs. Juniper and pinyon were apparently less common on the Blanding soil, also in the southern part of the Area. Grasses, forbs, and shrubs failed to flourish on the Blanding soil, however, because of the wide fluctuations in annual rainfall and the frequent occurrence of very dry seasons.

The vegetation on Alluvial soils, such as the Pack, Shay, Vega, and Ackmen, which occur along narrow, entrenched streams, consisted mainly of grasses and forbs. Moisture conditions were more favorable where these soils occur than they were in neighboring areas in the uplands. The growth of grasses, which have roots that penetrate deeply, was consequently greater on the Alluvial soils and is reflected in the higher content of organic matter in the soils.

Topography, or landform

Most of the San Juan Area is at an elevation of 6,000 to 7,000 feet. East of Monticello, the elevation is generally near 7,000 feet, but in the vicinity of Blanding it is about 1,000 feet lower. The bottoms of deeply incised canyons are at still lower elevations.

A major part of the survey area lying east of Monticello consists of a broad, gently undulating to rolling plain, cut by a few deep canyons. For the most part, this plain has a branching system of drainageways and is generally covered by a mantle of eolian sediments. There is a similar plain near Blanding.

The few deep canyons are striking features of the Area. Most of them begin in the northern part of the survey area and then deepen as they extend southward. The walls of the canyons are capped by rimrock. Steps, or talus-covered slopes, form the walls and descend to sandy streambeds. At the head of each canyon is the narrow, rather shallow valley of an intermittent stream, or upland drainageway. Along the walls of the deepest canyons, air turbulence, in the form of updrafts, and very rapid runoff have largely precluded parent materials from accumulating and forming soils. In some of the canyons recent accelerated erosion has cut deep channels in the narrow flood plains. Consequently, this has drained those flood plains and has greatly reduced their value for grazing.

The part of the Area west of Monticello borders the Abajo Mountains and consists of old, dissected, cobbly alluvial fans. These fans slope generally eastward and now have rolling to steep topography. The fans comprise the foothills for the mountains to the west.

The outcrops of Mancos shale consist of dominantly rounded hills separated by gently sloping areas of colluvial or alluvial deposits. Some of these alluvial areas are gullied as the result of accelerated erosion. Where these shaly hills coalesce with the uplands mantled by eolian sediments, the local relief is commonly more subdued and becomes rolling.

Parent materials

Most of the soils in the San Juan Area have formed in parent materials derived from three main sources.[3] One of these sources is a dark reddish-brown mantle of eolian sediments that contain 40 percent or more very fine sand and less than 40 percent silt. This mantle ranges from a few inches to 10 feet or more in thickness. In the deep deposits there are evidences of at least two distinct periods of deposition.

[3] GREGORY, HERBERT E., THE SAN JUAN COUNTRY. A GEOGRAPHIC AND GEOLOGIC RECONNAISSANCE OF SOUTHEASTERN UTAH. U. S. Geol. Survey Prof. Paper 188, 123 pp., illus. 1938.

The source of the eolian sediments is debatable. They could have come from the windswept Monument Valley area of Utah and Arizona, 60 miles southwest of Blanding. The high content of very fine sand and the relatively low content of silt, however, suggest a more local origin. The deeply cut channels of ephemeral streams that drain the Area toward the southwest are sandy and dry. The prevailing southwesterly winds sweep these dry channels. They pick up very fine sandy loam materials and deposit them on the adjacent uplands. The average content of silt in the B_2 horizon of the soils formed in this material is 26.7 percent at Blanding in the southern part of the Area. It increases to 35.6 percent at Old La Sal, which is in the northern part. Apparently, the content of silt in the B_2 horizon increases as the distance from the larger channels increases.

The eolian material is relatively low in free lime and is of mixed mineralogical composition. The ratio between cation-exchange capacity (milliequivalents per 100 grams) and the percentage of clay is in the range of 0.7 to 1.0. The soils of the Monticello and Blanding series have formed in this material. In these soils the lime has leached from the surface horizon and there is a slight increase in lime in the lower horizons.

The second main source of parent materials is the Dakota sandstone, which underlies much of the Area. In places ridges and knolls of Mancos shale overlie the sandstone. The sandstone is calcareous, and the shale is strongly calcareous. Locally, at least, the shale is also saline.

Materials weathered from sandstone make up the parent material of the Mellenthin soils, and they also comprise part of the material in the lower horizons of the Northdale and Montvale soils. The Northdale and Montvale soils formed in areas where a thin mantle of eolian sediments rests on the sandstone.

The Lockerby, Ucolo, Menefee, and Hovenweep soils formed partly in eolian materials and partly in materials weathered from Mancos shale. These soils are moderately fine textured, have a strongly calcareous horizon in their profile, and locally contain gypsum and more soluble salts.

The third main source of parent materials of soils in the Area consists of interglacial cobbly and gravelly alluvium from the Abajo and La Sal Mountains. This alluvium was derived from intrusive igneous rocks, such as diorite, andesite, dacite, and trachyte porphyries. The Abajo soils formed largely from this parent material, which is rich in clay-forming minerals. These source minerals for the formation of clay and the long interval of time that has elapsed during which horizon differentiation could take place has caused the Abajo soils to have a fine-textured B_2 horizon.

The ratio between the cation-exchange capacity, expressed in milliequivalents per 100 grams of soil, and the percentage of clay in the soils is related to the sources of parent materials in the San Juan Area. The ratio for the Abajo series is 0.9, but the ratio for soils formed in materials derived from shale is about 0.5. It is believed that soils formed from eolian and alluvial materials have significant amounts of vermiculite and montmorillonite in the clay fraction, but that the dominant clay mineral in soils from shale is mica. Micas have also been identified by X-ray analyses as characteristic minerals in the eolian deposits. The relationship between soils and the underlying geologic formations is shown in figure 13.

Time

The kinds of horizons in soils and the degree of expression of those horizons depend in part upon the time that has been available for their development. This can be illustrated by examples selected from the soils of the San Juan Area. Three degrees of horizonation can be recognized and described, which seem to reflect the time elapsed during soil formation.

The lowest degree of horizonation among the soils of the survey area exists in the Alluvial soils, examples of which are the soils of the Ackmen and Vega series. Occurring on flood plains that are covered by overflow waters from time to time, such soils periodically receive additional sediments. As a consequence, the time for differentiation of horizons in those soils has been short. Some organic matter has accumulated in the surface layer to form a faint A horizon, but further differentiation between the horizons has not yet occurred. Because of their youth, the Alluvial soils lack evident horizons.

Apparently somewhat older than the Alluvial soils are such members of the Brown soil group as the Monticello soils. The profile of the Monticello soils consists of a readily recognizable A horizon; a faint to evident B horizon, expressed mainly in color, structure, and consistence; and an evident C_{ca} horizon. The topographic occurrence of Monticello soils suggests that they have been subject to horizon differentiation for a considerable, but not an extremely long, interval of time.

Among the soils of the survey area, those in the Abajo series seem to be the oldest; that is, they have been subject to horizon differentiation for the longest interval of time. The Abajo soils have a distinct B horizon of clay accumulation not found in any of the other soils of the Area. This, in itself, indicates that the formation of the soils has been in progress for a long while. Moreover, the soils occupy what seem to be the oldest stable land surfaces in the San Juan Area.

The cobbly alluvium from which the Abajo soils have largely formed was apparently deposited in a previous geomorphic cycle, possibly in late Pleistocene time.[4] There is consequently the possibility that the Abajo soils were formed in part under climatic conditions unlike those of the present day. Thus, the greater degree of horizonation in the Abajo soils may not be caused entirely by a greater interval for horizon differentiation. It seems clear, however, that the Abajo soils have been forming over a longer period of time than other soils in the survey area.

Classification of Soils

In the following pages the soil series of the survey area are classified by great soil groups and orders. These are categories in the scheme of classification originally

[4] GREGORY, HERBERT E. THE SAN JUAN COUNTRY. A GEOGRAPHIC AND GEOLOGIC RECONNAISSANCE OF SOUTHEASTERN UTAH. U.S. Geol. Survey Prof. Paper 188, 123 pp., illus. 1938.

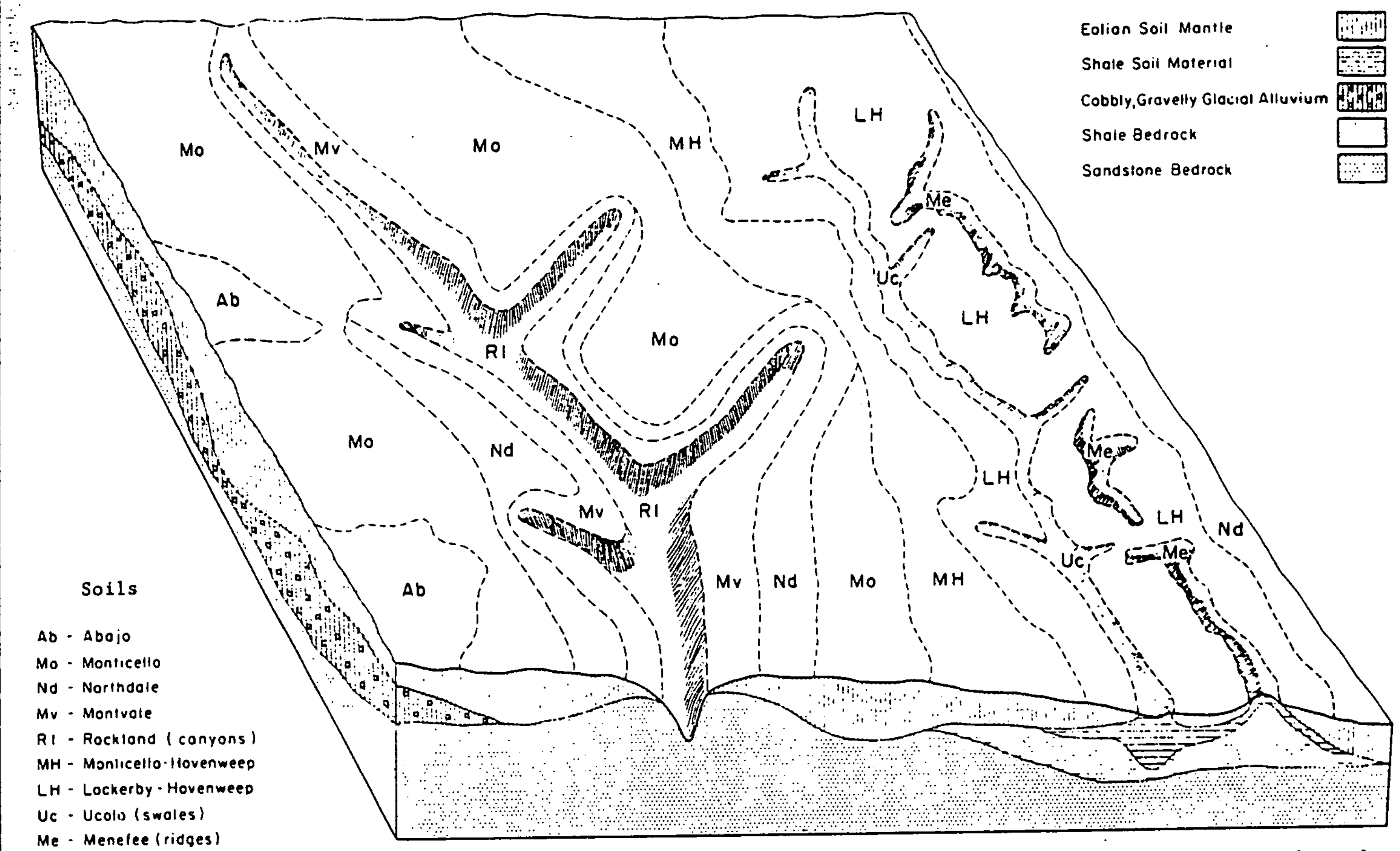

Figure 13.—Cross section from west to east through the San Juan Area, Utah, showing relationship between the soils and the underlying geologic formations.

outlined by Baldwin, Kellogg, and Thorp in 1938[5] and later modified by Thorp and Smith.[6] One departure from that scheme of classification is the placement of two series in the Calcisol great soil group, which was proposed by Harper in 1957.[7]

The soil series, the great soil group, and the order are three of the four categories of the general system of soil classification that have been widely used in the United States for the last two decades. The fourth category that is widely used is that of the soil type.

Each category consists of a number of classes of the same rank. Individual classes have broad spans in the higher categories (order and great soil group), and they have narrow spans in the lower categories (series and type). This can be illustrated by the numbers of classes in each of the categories; that is, there are 3 orders, some 40 great soil groups, approximately 7,000 soil series, and perhaps 15,000 soil types recognized in the United States.

The nature of the order, great soil group, soil series, and soil type are not described at length in this report, but the soil series and soil type are discussed in an earlier section "How Soils are Named, Mapped, and Classified." The orders and great soil groups are described briefly in the following paragraphs.

The order, the highest category in the system of soil classification now in use, consists of three classes known as zonal, intrazonal, and azonal soils. These may also be identified as the zonal, intrazonal, and azonal orders. All soils of the United States are placed in these three classes (orders) in this system of classification.

The zonal order consists of soils with evident, genetically related horizons that reflect the dominant influence of climate and living organisms in their formation. The intrazonal order consists of soils with evident, genetically related horizons that reflect the dominant influence of one or more local factors of parent material, topography, and time over the effects of climate and living organisms. The azonal order consists of soils that lack distinct, genetically related horizons because of one or more factors, such as youth, resistance of parent material to change, and steep topography. Because of the way in which the soil orders are defined, soils of all three orders generally occur within a small geographic area, as is true for the San Juan Area.

The category of the great soil group consists of classes that are narrower in permissible range of properties than are orders. The category of the great soil group has

[5] U.S. DEPARTMENT OF AGRICULTURE. SOILS AND MEN. U.S. Dept. Agr. Ybk. 1938. 1232 pp., illus.

[6] THORPE, JAMES, AND SMITH, GUY D. HIGHER CATEGORIES OF SOIL CLASSIFICATION: ORDER, SUBORDER, AND GREAT SOIL GROUPS. Soil Sci. 67: 117-126. 1949.

[7] HARPER, W. G. MORPHOLOGY AND GENESIS OF CALCISOLS. Soil Sci. Soc. Amer. Proc. 21(4): 420-424 illus. July-August 1957.

been used widely because the classes indicate relationships in the formation of soils, in fertility status, in suitability for various types of plants, and so on.

Each great soil group consists of a large number of soil series, in which the soils have many internal features in common. Thus, the soils of all series placed in one great soil group in either the zonal or intrazonal orders have the same number and kinds of definitive horizons in their profiles. These horizons need not be expressed to the same degree, nor do they need to be of the same thickness, in all soils within one great soil group. Certain horizons, however, must be evident in every profile of a soil that falls within a given great soil group.

Great soil groups in the azonal order are defined, in part, according to the characteristics of the profile and, in part, according to the history or origin of the soil. All members of a great soil group have certain internal features in common, but none of the soils in the three great soil groups in the azonal order have distinct horizonation. Consequently, all of them still bear a strong imprint of the weathered rock from which they formed. The definitions of great soil groups in the azonal order are centered on a vertical section approximately as deep as the profiles of associated zonal and intrazonal soils.

Table 8 gives the classification of soil series of the San Juan Area by great soil groups and orders. Also indicated for each series are the parent material, topography, and natural drainage. Thus, the 15 soil series of the survey area are classified into 6 great soil groups. Two great soil groups belong to the zonal order, one to the intrazonal order, and three to the azonal order.

Morphology and Composition of Soils

This section discusses selected morphological features of the soils and gives data on their composition. The individual series are discussed under the great soil group in which they have been placed, and a brief definition of the great soil group is given.

A detailed description of a profile that is representative of the series is not included in this section because a representative profile for each series is given in an earlier part of the report. Table 9, in the section "Laboratory Analyses of Soils," gives data on particle-size distribution, by horizons, for profiles of a number of soil types. Table 10 gives partial chemical analyses of samples taken from the same profiles and from the profiles of several additional soil types.

TABLE 8.—*Soil series classified by great soil group, parent material, relief, and drainage*

Great soil group and series	Parent material	Topography	Natural drainage
ZONAL SOILS			
Reddish Brown soils:			
Abajo	Weathered diorite, andesite, dacite, and surface eolian material.	Old, dissected stream terraces	Well drained.
Monticello	Eolian material	Broad, gently rolling uplands	Well drained.
Montvale	Weathered Dakota sandstone and some eolian material.	Gentle to steep slopes, ridges, and plains	Well drained.
Northdale	Eolian material over sandstone bedrock	Gently rolling uplands	Well drained.
Scorup	Old alluvium from fine-grained igneous rocks	Gently to moderately sloping, old alluvial fans and terraces.	Well drained.
Sierozems:			
Blanding	Eolian material	Rolling uplands	Well drained.
INTRAZONAL SOILS			
Calcisols:			
Hovenweep	Eolian deposits over decomposing shale	Gently sloping to rolling uplands	Well drained.
Mellenthin	Weathered, limy sandstone	Moderate to steep slopes and ridges	Well drained.
AZONAL SOILS			
Alluvial soils:			
Ackmen	Mixed medium-textured alluvium	Alluvial fans and narrow valleys of streams.	Well drained.
Pack	Medium-textured alluvium from igneous rock.	Alluvial fans and narrow valleys of streams.	Imperfectly drained.
Shay	Fine-textured, dark alluvium from shale	Narrow valleys of streams	Imperfectly drained.
Ucolo	Moderately fine textured to fine textured alluvium.	Narrow valleys of streams	Moderately well drained.
Vega	Moderately fine textured alluvium	Narrow valleys of streams	Moderately well drained.
Lithosols:			
Menefee	Weathered shale	Gently to steeply sloping ridges and hills	Well drained.
Regosols:			
Lockerby	Weathered Mancos shale with a thin mantle of eolian sediments.	Smooth to gently rolling uplands	Moderately well drained.

Reddish Brown soils

Reddish Brown soils belong to the zonal order. These soils have a brown surface horizon that grades to lighter colored materials. They also have an accumulation of calcium carbonate at a depth of 1 to 3 feet. These soils have formed under short grasses, bunch grasses, and shrubs in a temperate to cool, subhumid climate.

The soils in five of the soil series in the San Juan Area—the Abajo, Monticello, Montvale, Northdale, and Scorup—are classified as Reddish Brown soils. The soils of these five series comprise a major part of the acreage in the survey area.

Although these five series are all members of one great soil group, the soils differ appreciably in degree of horizonation, or profile development. The Abajo soils have much more distinct horizons than the soils of the other four series. This distinction is mainly in the nature of the B horizon, which is high in clay in the Abajo profile but not in the other soils. Furthermore, the characteristics of the B horizon of the Abajo soils indicate that a substantial amount of clay has accumulated during the process of horizon differentiation.

Clearly evident accumulations of clay do not mark the B horizons of the Monticello, Montvale, Northdale, and Scorup soils. The Montvale soils are decidedly stony and are shallow to very shallow. They, therefore, may be considered as Reddish Brown soils that are marginal to the Lithosols in a number of characteristics. Scorup soils have a cemented layer of lime in the lower part of the profile rather than a soft horizon of carbonate accumulation.

The A horizons in the soils of all five series in the Reddish Brown great soil group are similar in characteristics, and the A horizons contain from 1.6 to 2.3 percent of organic matter. Except in the Abajo soils, carbonates have been concentrated in the profiles of all of these soils at a depth near 18 inches, and traces remain in the upper part of the profile, as indicated in table 10. In the Abajo soils, there is a slight accumulation of carbonates beginning at a depth of 20 inches, but this accumulation is far less evident than in other Reddish Brown soils of the Area.

The Abajo soils are of special interest. They have some characteristics similar to those of Chestnut soils, and others like those of Planosols. The solum is thicker, on the whole, than normal for Reddish Brown soils, being comparable to the profiles of the Chestnut soils. The marked accumulation of clay in the B horizon is a feature shared with many Planosols, though the Abajo soils lack an abrupt boundary between the A and B horizons.

The data for particle-size distribution, given in table 9, indicate that geological materials are discontinuous within the Abajo profile. The A_1 horizon in the Abajo profile seems to include an important component of eolian materials that are absent from the B and C horizons. Thus, the profile as a whole is formed partly in loess, or eolian sediments, and partly in the underlying cobbly alluvium. In the Abajo profile the contrast between the original loess and alluvium seems to have been accentuated by horizon differentiation.

Sierozems

Sierozems belong to the zonal order. These soils have a relatively light colored surface horizon. The lower part of the surface horizon grades to still lighter colored materials that are marked by an accumulation of calcium carbonate. For the most part, the surface horizon is grayish brown to light brownish gray. The Sierozems formed under mixed shrubs and grasses in a temperate to cool, arid climate.

In this survey area the only soil series in the Sierozem great soil group is the Blanding. The soils of the Blanding series are in the extreme southwestern, and driest, part of the Area. They formed in the same kind of eolian sediments as the Monticello soils, but the Blanding soils have a darker A_1 horizon than is normal for Sierozems, which indicates that they are marginal to the Reddish Brown great soil group in many ways. The A_1 horizon is lower in organic matter (less than 1 percent) than is that of the Reddish Brown soils. Furthermore, the depth of leaching of carbonates is 16 inches or less in the Blanding soils. In this respect the Blanding soils also closely resemble the Monticello soils. This is to be expected, since the comparable Reddish Brown soils and Sierozems in this Area formed from the same kind of parent materials and occur under a climate that differs but little.

Calcisols

Calcisols belong to the intrazonal order. They have a surface horizon of various colors and thicknesses. They lack textural B horizons and overlie a horizon of calcium carbonate accumulation. These soils have formed from highly calcareous parent materials under a climate ranging from subhumid to arid. Recognition of a separate great soil group for these soils was proposed recently by Harper. (See footnote 7, p. 39.) For that reason, few descriptions and analytical data for these soils have as yet been published.

Two series in the survey area have been classified as Calcisols. These are the Hovenweep and Mellenthin. The soils of the Hovenweep series are associated with the Reddish Brown soils, and those of the Mellenthin series, with Sierozems.

The Hovenweep soils formed, in part, from eolian sediments and, in part, from weathered residuum from Mancos shale. Because the shale is highly calcareous and slowly permeable, the downward leaching of carbonates has not progressed far enough to allow the removal of the carbonates from the A horizon. At the same time, a prominent C_{ca} horizon has formed in the lower part of the profile. The Hovenweep soils have an A horizon that is dark reddish brown. They lack a B horizon and have a gradational AC horizon between the A_1 and C_{ca} horizons.

As already indicated, the Mellenthin soils are associated with the Sierozems, which are in the drier part of the survey area. These soils have an A_1 horizon that is comparable in color, though appreciably thinner, than that of the Hovenweep soils. The soils of both series seem to have a component of loess in the upper part of the profile. In contrast to the Hovenweep soils, however, the Mellenthin soils are commonly stony and are shallow over calcareous sandstone. The Mellenthin soils have prominent accumulations of calcium carbonate in their profiles, immediately above the bedrock.

Alluvial soils

Alluvial soils belong to the azonal order. They have formed from geologically recent alluvium and lack evident horizons, though the surface layer may have gained some organic matter. Five series in the San Juan Area—the Ackmen, Pack, Shay, Ucolo, and Vega—are classified as members of the Alluvial great soil group. The soils of these five series are on narrow flood plains, in the valleys of streams, on upland alluvial fans, or on accumulations on side slopes.

The soils in this great soil group are distinguished chiefly by the dominant texture of the profile and by drainage. The Ackmen soils are medium textured and well drained, whereas the Pack soils are medium textured but imperfectly drained. The Shay and Ucolo soils are fine textured, but the Shay soils are imperfectly drained, and the Ucolo soils are moderately well drained. The Vega soils are moderately fine textured and are moderately well drained.

All of these soils are forming in deposits that are many feet thick. The distinctions among them are based on differences in dominant texture. These distinctions in texture have been made because it is believed they reflect the mineralogical composition of the sediments and tend to govern the movement of water through the soil. Both the mineralogical composition of the sediments and the rate at which water moves through the soil have an important effect on the direction and rate of horizon differentiation.

Lithosols

Lithosols belong to the azonal order. They lack evident, genetically related horizons. The soils are very stony or very shallow over bedrock, or both. In contrast to the Regosols, the Lithosols in this Area are either shaly or cobbly and have hard rock at a shallow or very shallow depth. The mantle of unconsolidated materials is thin in these soils.

In the San Juan Area, only the soils of the Menefee series are classified as Lithosols. Like the soils in the Lockerby series, the Menefee soils formed in materials weathered from Mancos shale, but the regolith, or mantle of disintegrated rock materials, is shallower than that in which the Lockerby soils developed. The Mancos shale varies locally in hardness and in resistance to weathering. The Menefee soils may occur in areas where the rock weathers less readily than it does in some other places.

The Menefee soils are calcareous throughout. They have a thin, indistinct A_1 horizon, a faint AC horizon, and a clearly evident D_r horizon. The average depth to the D_r horizon of fractured shale is 14 inches.

The Menefee soils lack the distinct to prominent horizon of carbonate accumulation that is present in the Hovenweep and Mellenthin soils. This horizon of carbonate accumulation is the basis for classifying the Hovenweep and Mellenthin soils as Calcisols.

Regosols

Regosols belong to the azonal order. These soils lack evident, genetically related horizons. They are forming in deep, unconsolidated regoliths or in materials from soft rocks. The distinction drawn between Regosols and Lithosols rests on the thickness of the regolith or on a combination of the stoniness and the thickness of the regolith. Roots can penetrate to considerable depth in the Regosols.

In the San Juan Area, only the soils in the Lockerby series are classified as Regosols. Like the Menefee soils, they have formed in materials weathered from Mancos shale. They have a faint A_1 and AC horizon, but, unlike the Menefee soils, fractured parent shale is at a moderate depth. The Lockerby soils lack the prominent horizon of carbonate accumulation common to the Hovenweep soils.

The data in table 10, showing the levels of calcium carbonate by horizons, indicate that some leaching has taken place in the Lockerby soils. The leaching has not been extensive enough, however, to give rise to a distinct layer of carbonate accumulation. At the same time, the grade of structure in the AC horizon suggests that the Lockerby soils are beginning to take on some characteristics of Reddish-Brown soils.

Laboratory Analyses of Soils

The results of mechanical analyses of samples of representative soils of the San Juan Area are given in table 9. The results of chemical analyses of the same soils and of several additional soils are given in table 10. The samples were analyzed and determinations were made at the Soil Conservation Service-Utah State University Cooperative Soils Laboratory, Logan, Utah.

TABLE 9.—*Mechanical analyses of representative soils*

[Where no figures are given, determinations were not made]

Soil type and horizon	Depth	Very coarse sand (2.0–1.0 mm.)	Coarse sand (1.0–0.5 mm.)	Medium sand (0.5–0.25 mm.)	Fine sand (0.25–0.10 mm.)	Very fine sand (0.10–0.05 mm.)	Silt (0.05–0.002 mm.)	Clay (less than 0.002 mm.)
		Size class and diameter of particles [1]						
	Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Abajo loam:								
A_{11}	0–2	0.5	0.3	1.3	5.5	44.4	33	15
A_{12}	2–10	.9	.6	2.1	6.0	42.3	27	21
B_{21}	10–20	.04	.1	1.7	5.6	12.56	35	45
B_{22}	20–40	1.5	1.8	6.6	9.0	13.1	33	35
C_1	40–50	2.8	3.2	9.3	11.6	16.1	28	29
Ackmen silt loam:								
A_{11}	0–3	.25	.35	4.0	5.8	20.6	56	13
A_{12}	3–7	.3	.8	5.5	4.4	15.5	58	15
C_1	7–32	.1	.4	3.0	4.5	20.0	49	23
C_2	32–71	.5	.8	5.6	5.7	14.4	48	25
C_3	71+						44	27
Blanding very fine sandy loam:								
A_1	0–4			.3	8.4	53.3	22	16
B_2	4–16			.5	7.4	49.1	22	21
C_{ca}	16–50	.05	.05	.5	7.0	49.4	23	20
B_{2b}	50–58	.05	.05	.4	7.5	52.0	18	22
C_{cab}	58–68	.1	.2	1.1	6.1	51.5	19	22
Hovenweep loam:								
A_{11}	0–2	.4	.2	.7	2.5	33.2	46	17
A_{12}	2–5	.4	.3	1.2	3.0	27.1	46	22
A_{13}	5–10	.8	.3	1.1	3.3	22.5	47	25
AC	10–15	.5	.4	2.1	6.0	20.0	41	30
C_{ca1}	15–22							
C_{ca2}	22–32	.6	.5	2.8	9.9	15.2	36	35
Lockerby silty clay loam:								
A_1	0–4	.2	.4	.4	1.7	16.3	43.4	37.6
AC	4–13	.1	.1	.1	1.0	13.0	42.9	42.8
C_{11}	13–26			.1	1.0	11.9	42.6	45.4
C_{12}	26–38	.2	.3	.5	2.5	11.5	38.5	46.5
Monticello very fine sandy loam:								
A_{11}	0–3	.4	.2	1.0	6.1	42.3	29	21
A_{12}	3–8	.1	.2	.9	5.9	44.9	31	17
B_{21}	8–22	.1	.1	.5	4.7	38.6	34	22
B_{22}	22–32	.2	.2	.6	3.5	33.5	38	24
B_3	32–45	.2	.2	.7	4.5	34.4	37	23
C	45–56	.4	.4	1.1	5.5	37.6	35	20
Montvale very rocky very fine sandy loam:								
A_1	0–3	.15	.15	4.0	24.6	26.1	30	15
B_1	3–7	.1	.1	4.2	25.5	25.1	28	17
B_2	7–13	.2	.2	4.3	24.8	22.5	28	20
B_{3ca}	13–18	.1	.1	4.5	24.4	19.9	26	25
Northdale loam:								
A_1	0–3½	.2	.1	1.6	7.0	37.1	39	15
B_1	3–8	.1	.1	1.3	6.3	37.2	37	18
B_2	8–19	.15	.15	2.0	6.5	33.2	33	25
B_{3ca}	19–28	.8	.5	2.6	8.7	27.4	33	27
C_{ca}	28–31	2.0	2.1	5.9	10.4	20.6	30	29
Scorup very fine sandy loam:								
A_{11}	0–4	.9	2.2	1.9	7.7	47.5	27.1	12.7
A_{12}	4–9	1.3	1.7	1.3	7.3	43.4	29.2	15.8
B_1	9–15	1.3	2.3	1.6	7.6	41.7	27.0	18.5
B_2	15–22	1.9	2.4	1.6	7.6	40.9	28.4	17.2
B_{3ca}	22–31	1.5	2.6	1.9	8.3	40.1	26.4	19.2

See footnote at end of table.

TABLE 9.—*Mechanical analyses of representative soils*—Continued

[Where no figures are given, determinations were not made]

Soil type and horizon	Depth	Size class and diameter of particles[1]						
		Very coarse sand (2.0–1.0 mm.)	Coarse sand (1.0–0.5 mm.)	Medium sand (0.5–0.25 mm.)	Fine sand (0.25–0.10 mm.)	Very fine sand (0.10–0.05 mm.)	Silt (0.05–0.002 mm.)	Clay (less than 0.002 mm.)
	Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Ucolo silty clay loam:								
A_{11}	0–2		.02	.16	10.56	21.26	54	23
A_{12}	2–10		.08	.73	1.63	12.56	57	28
C_1	10–20	.13	.1	.45	2.12	10.2	46	41
C_1	20–30	.24	.029	.56	2.08	8.83	43	45
C_2	30–42	.08	.14	.59	2.53	12.66	30	44
C_2	42–53	.17	.17	.36	3.10	15.2	31	48
C	53–72	.09	.09	.33	1.89	8.6	41	48
Vega clay loam:								
A_1	0–4	.42	.66	7.3	8.7	17.92	35	30
C_{11}	4–15	.2	.8	5.7	8.1	17.2	39	29
C_{12}	15–30	.22	.34	2.0	4.24	21.2	47	25
C_{13}	30–40	.08	.1	1.1	3.17	20.55	48	27
C_4	40–52						48	38

[1] The percentages of the various fractions total approximately 100 percent.

Additional Facts About the Area

This section gives facts about the early settlement and development of the San Juan Area. It also describes transportation facilities in the Area and gives facts about agriculture and irrigation.

Early Settlement and Development

The history of early white settlement in San Juan County is a record of the exploration and utilization of some 5,000 square miles of land. This land had not previously been used for grazing or cultivated crops.

The first pioneer settlers left southwestern Utah in the spring of 1879 to come to this Area, and they arrived after almost insurmountable hardships. By the spring of 1880, they had organized the town of Bluff City, which is now known as Bluff. These first settlers soon took up ranching. By 1885, ranching had become the primary industry.

The settlers grazed their livestock in the Abajo Mountains in summer, but they needed supplementary feed for the animals. To supply this need, they began to grow alfalfa and grain on dry land and on small, irrigated areas. This led, in 1887, to the organization of Monticello, originally known as the tough cattle town of Hammond. The town of Carlisle was established in 1889, and Verdure, in 1894. The hope that they could use the land successfully for dryfarming encouraged a few settlers to take up land east of Monticello in the areas known as Lockerby and Ucolo. Other settlers, in 1905, established the town of Blanding.

Transportation Facilities

The principal highway in the San Juan Area is U.S. Highway No. 160. This highway enters the Area from the north, turns east at Monticello, and continues on into Colorado. Thompson, Utah, which is 95 miles north of Monticello and on U.S. Highway No. 160, is the nearest railroad shipping point. The part of the Area south of Monticello is served by State Highway 47, which is hard surfaced south to the Arizona line.

Recently, many access roads that lead to the uranium mines and gas and oil fields have been constructed. Most of these consist of graded or bulldozed trails, but some are well constructed all-weather roads. These roads give access to much of the Area that formerly was served only by trails suitable for wagons or jeeps.

Agriculture

Agriculture in the Area consists mainly of livestock raising and dryfarming. Dry-farmed wheat and pinto beans are the principal crops. Because of extreme fluctuations in precipitation, however, both from year to year and within the year, crops often fail.

The number of farms has decreased slightly during the past few years, but the total acreage in farms has increased. In 1950, there were 353 farms in San Juan County and a total of 467,326 acres was farmed. By 1954, the number of farms had decreased to 272, but the total acreage in farms had increased to 496,485 acres.

TABLE 10.—*Chemical analyses of representative soils*

Soil type and horizon	Depth	Reaction		Organic matter				Estimated percent of salt by bureau cup	Electrical conductivity (Ec×10³)	$CaCO_3$ equivalent	Cation exchange capacity	Exchangeable sodium percentage
		Saturated paste	1:5 ratio	Total organic matter	Organic carbon	Nitrogen	C/N ratio					
	Inches	*pH*	*pH*	*Percent*	*Percent*	*Percent*			*Mmho. per cm. at 25° C.*	*Percent*	*Meq. per 100 gm. of soil*	
Abajo loam:												
A_{11}	0–2	7.1		1.96	1.14	0.095	12.0	0.03	0.63	0.2	12.6	2
A_{12}	2–10	7.2		1.58	.92	.087	10.6	.04	.50	.1	16.7	1
B_{21}	10–20	7.1		1.03	.60	.051	11.8	.04	.36	.3	27.1	2
B_{22}	20–40	7.7		.55	.32	.033	9.7	.06	.33	2.6	36.8	1
C_1	40–50	8.2		.38	.22	.029	7.6	.05	.36	.6	30.4	1
Ackmen silt loam:												
A_{11}	0–3	7.6	8.2	3.96	2.30	.173	13.3	.03	.73	.1	23.7	0
A_{12}	3–7	7.5	8.0	2.99	1.74	.123	14.1	.02	.68	.2	23.9	1
C_1	7–32	7.7	8.2	1.87	1.09	.089	12.2	.04	.93	.2	23.7	1
C_2	32–71	7.4	7.8	1.44	.84	.064	13.1	.09	1.43	.1	25.1	1
C_3	71+	7.8	8.1	2.08	1.21	.071	17.0	.07	.98	.1	27.5	1
Blanding very fine sandy loam:												
A_1	0–4	8.1		.89	.52	.045	11.6	.03	.51	.3	11.4	2
B_2	4–16	7.7		.65	.38	.040	9.5	.04	.41	.3	14.2	2
C_{ca}	16–50	8.1		.38	.22	.028	7.9	.02	.40	3.6	11.0	2
B_{2b}	50–58	8.2		.28	.16	.030	5.3	.03	.52	1.5	14.3	5
C_{cab}	58–68	8.3		.14	.08	.015	5.3	.07	1.07	11.5	13.8	6
Hovenweep loam:												
A_{11}	0–2	8.0		2.00	1.16	.101	11.5	.05	.65	3.8	18.2	2
A_{12}	2–5	7.7		2.65	1.54	.129	11.9	.04	.62	5.9	21.0	1
A_{13}	5–10	8.0		2.22	1.29	.120	10.8	.04	.67	16.8	21.7	1
AC	10–15	8.1		2.05	1.19	.092	12.9	.03	.35	31.7	18.0	2
C_{ca1}	15–22											
C_{ca2}	22–32	8.3		1.29	.75	.055	13.6	(1)	.32	68.2	11.4	2
D_{rca}	32–38	8.1		1.27	.74	.048	15.4	.03	.28	65.2	15.9	2
Lockerby silty clay loam:												
A_1	0–4	8.0	8.8	1.63	.95	.095	10.0	.06	.60	13.9	20.4	
AC	4–13	8.3	9.2	.88	.51	.055	9.3	.05	.60	17.8	21.0	7
C_1	13–26	8.2	9.5	.62	.36	.035	10.3	.09	1.4	20.2	23.0	13
C_2	26–38	8.1	8.7	.62	.36	.034	10.6	.79	12.8	24.4	24.5	23
D_r	38–52	8.4	8.4	.58	.34	.029	11.7	1.10	14.6	25.2	40.7	14
Mellenthin very rocky fine sandy loam:												
A_1	0–4	8.0	8.5	.89	.52	.055	9.5	.03	.60	6.8	12.3	
C_{ca1}	4–11	8.3	8.9	1.20	.70	.059	11.8	.03	.50	24.4	11.5	
C_{ca2}	11–15	8.1	9.0	1.20	.70	.066	10.6	(1)	.50	35.4	9.9	
Menefee clay loam:												
A_1	0–2	7.8	8.4	2.44	1.42	.108	13.1	.05	.50	10.5	26.2	
AC	2–10	7.7	8.7	3.03	1.76	.126	14.0	.05	.70	12.1	27.0	
CD_r	10–14	7.7	8.8	2.39	1.39	.099	14.0	.03	.50	50.0	20.8	
Monticello very fine sandy loam:												
A_{11}	0–3	6.8	7.3	2.26	1.33	.099	13.4	(1)	.46	.1	14.6	1
A_{12}	3–8	6.9	7.1	1.38	.81	.071	11.4	(1)	.31	.1	14.7	1
B_{21}	8–22	7.2	7.8	.70	.41	.044	9.3	(1)	.26	.1	27.2	1
B_{22}	22–32	7.3	7.9	.46	.27	.039	6.9	.03	.25	.1	21.3	1
B_3	32–45	7.9	8.5	.27	.16	.026	5.7	.03	.34	.9	18.1	2
C	45–56	8.1	8.8	.27	.16	.025	6.4	.03	.33	1.6	14.2	2
Montvale very rocky very fine sandy loam:												
A_1	0–3	7.8	8.1	2.08	1.21	.081	14.9	.02	.43	.1	16.3	1
B_1	3–7	7.7	8.0	1.79	1.04	.077	13.5	.02	.51	.2	17.0	1
B_2	7–13	7.6	8.2	1.38	.80	.065	12.3	.02	.64	.2	18.3	1
B_{3ca}	13–18	8.0	8.7	2.27	1.32	.089	14.8	.03	.58	21.0	24.6	1

See footnote at end of table.

TABLE 10.—*Chemical analyses of representative soils*—Continued

Soil type and horizon	Depth	Reaction: Saturated paste	Reaction: 1:5 ratio	Organic matter: Total organic matter	Organic matter: Organic carbon	Organic matter: Nitrogen	Organic matter: C/N ratio	Estimated percent of salt by bureau cup	Electrical conductivity ($Ec \times 10^3$)	$CaCO_3$ equivalent	Cation exchange capacity	Exchangeable sodium percentage
	Inches	*pH*	*pH*	*Percent*	*Percent*	*Percent*			*Mmho. per cm. at 25° C.*	*Percent*	*Meq. per 100 gm. of soil*	
Northdale loam:												
A_1	0–3	7.9	8.6	2.06	1.20	0.103	11.6	0.03	0.46	0.3	17.0	1
B_1	3–8	7.6	8.3	1.24	.72	.071	10.1	.03	.39	.2	17.5	1
B_2	8–19	7.5	8.2	1.03	.60	.070	8.6	.04	.42	.1	23.0	1
B_{3ca}	19–28	8.2	9.1	.83	.48	.049	10.0	.03	.32	29.0	17.2	1
C_{ca}	28–31	8.3	9.1	.96	.56	.055	10.4	(1)	.35	40.0	14.4	1
Pack silt loam:												
A_{11}	0–4	7.6	8.4	6.12	3.56	.214	16.6	.02	.76	.20	28.6	1
A_{12}	4–25	7.6	7.9	2.56	1.49	.091	16.4	.03	.72	.30	24.4	1
Scorup very fine sandy loam:												
A_{11}	0–4	8.5	9.2	2.03	1.18	.098	12.0	.03	.70	.30	12.7	9
A_{12}	4–9	8.1	8.7	1.65	.96	.0[illegible]0	10.7	.03		.10	15.2	
B_1	9–15	7.9	8.3	1.32	.77	.065	11.8	.03		.10	16.6	
B_2	15–22	8.0	8.6	1.19	.69	.066	10.4	.03		2.80	15.7	
B_{3ca}	22–31	7.9	8.9	1.34	.78	.070	11.1	.16	4.10	10.60	16.0	8
C_{ca}	31–44	8.2	8.9	1.43	.83	.064	12.9	.35	12.00	49.90	12.4	10
C_{cam}	44–56	8.8	9.4	.89	.47	.052	9.0	.07	4.10	48.00	11.2	10
Shay clay loam:												
Ap	0–3	7.6	8.5	3.68	2.14	.188	11.4	.09	1.30	3.20	25.7	
AC	3–12	7.8	8.6	2.72	1.58	.125	12.6	.05	.80	3.50	24.2	
C_{1g}	12–30	7.9	8.7	3.51	2.04	.182	11.2	.10	1.70	7.10	27.8	
C_{2g}	30–40	7.6	8.1	1.95	1.15	.101	11.4	.21	4.00	.50	37.3	
Ucolo silty clay loam:												
A_{11}	0–2	8.2		1.81	1.05	.093	11.3	.04	.61	15.80	15.6	1
A_{12}	2–10	8.2		1.67	.97	.090	10.8	.04	.43	15.50	16.6	3
C_1	10–20	8.4		.98	.57	.058	9.8	.09	3.30	19.20	18.7	9
C_1	20–30	8.4		1.01	.59	.048	12.3	.40	6.70	19.90	18.7	27
C_2	30–42	8.3		.71	.41	.041	10.0	1.49	18.70	17.00	18.2	22
C_2	42–53	8.3		.77	.45	.039	11.5	1.28	19.40	19.10	21.3	16
C_3	53–72	8.4		.58	.34	.037	9.2	.80	12.20	40.80	17.1	15
Vega clay loam:												
A_1	0–4	7.7	8.6	3.27	1.90	.131	14.5	.06	1.57	7.20	24.0	1
C_1	4–15	7.6	8.3	2.86	1.66	.121	13.7	.22	6.00	7.80	26.6	3
C_2	15–30	7.5	8.1	2.86	1.66	.139	11.9	.46	11.70	1.80	26.7	7
C_3	30–40	7.7	8.5	2.24	1.30	.107	12.1	.29	6.70	2.60	27.5	12
C_4	40–52	7.9	8.5	1.44	.84	.081	10.4	.29	5.50	8.70	27.4	12

[1] Less than 0.02 percent.

In the following pages, facts about crops grown in the Area and other facts about the agriculture are discussed. The statistics used are from reports published by the U.S. Bureau of the Census. Other figures, showing the numbers of cattle and sheep in San Juan County in stated years, are given in the section "Range Management."

Crops

During World War I, dryfarming developed rapidly east of Monticello. Approximately 100,000 acres of land that had previously been unoccupied was farmed. In 1919, the total yield of crops harvested in the Area was the largest and most valuable of any yield on record prior to World War II, but total yields decreased markedly after that time. This decline was most pronounced during the 1930's.

When World War II began, a much larger acreage was planted to wheat, and a large acreage was planted to pinto beans, which had just been introduced in the Area. During this period, good prices were obtained for these crops, and there was a strong demand for them. In addition, heavy equipment for land clearing became available, which resulted in the cutting of brush and trees (pinyon pine and juniper) from a large acreage that had not been cleared previously.

Favorable moisture during the 1940's speeded the clearing of land for wheat and beans. Then, during the 1950's, there were extreme fluctuations in climate. This tended to stabilize the amount of acreage used for dryfarming or to cause it to decrease slightly. In 1950, crops were harvested from 55,736 acres, as compared to 48,846 acres in

1954. In 1954, the total value of all crops sold was approximately 41 percent of the total value of all farm products sold. The following gives the crops harvested in San Juan County in 1949 and 1954, and the total acreage of each crop:

Crop	*Acres (1949)*	*Acres (1954)*
Small grains threshed or combined:		
Winter wheat	32,499	30,605
Spring wheat	281	3,346
Barley	2,373	1,236
Oats	618	216
Other grains	298	191
Corn for all purposes	745	326
Dry field and seed beans harvested for beans	12,348	8,023
Alfalfa grown for hay	4,958	3,978
Alfalfa grown for seed	163	62

Farm tenure

Most of the farms in the Area are operated by owners or part owners. In 1950, 316 farms were operated by owners or part owners, as compared to 251 farms in 1954. In 1950, 31 farms, or 8.8 percent of the total number of farms, were operated by tenants. In contrast, only 15 farms, or 5.5 percent of the total number of farms, were operated by tenants in 1954. Both in 1950 and in 1954, 6 farms were operated by managers.

Irrigation

Irrigation agriculture is of only minor importance in the survey area. Additional land is suitable for irrigation, but the water supply is too limited for more irrigation. Most of the water used for irrigation is supplied by diverting it from intermittent streams that flow from the Abajo and La Sal Mountains. The only storage reservoirs are a few small ponds. These are used to store water at night for use during the day.

Many so-called irrigated fields get only one, or at most two, irrigations per season. The intermittent streams that provide water for irrigation early in the season are usually dry by mid-July. As a result, water is not available for irrigating most fields except early in the growing season.

GUIDE TO MAPPING UNITS, CAPABILITY UNITS, AND RANGE SITES [1]

Map symbol	Mapping unit	Page	Capability unit	Page	Range site	Page
AbD	Abajo loam, 0 to 10 percent slopes	25	IIIc-1	7	Upland Loam and Upland Loam (Pinyon-Juniper).	16, 17
AbGC	Abajo cobbly loam, 2 to 25 percent slopes	25	(2)		Upland Loam and Upland Loam (Pinyon-Juniper).	16, 17
AcGC	Abajo cobbly clay loam, 10 to 25 percent slopes.	25	(2)		Upland Loam and Upland Loam (Pinyon-Juniper).	16, 17
AlC	Ackmen loam, 0 to 6 percent slopes	26	IVc-2	9	Upland Loam	16
AlD2	Ackmen loam, 0 to 10 percent slopes, moderately eroded.	26	(2)		Upland Loam	16
AlD3	Ackmen loam, 0 to 10 percent slopes, severely eroded.	26	(2)		Upland Loam	16
AsBW	Ackmen silt loam, moderately deep water table, 0 to 3 percent slopes.	26	(2)		Semiwet Meadow	15
AsC	Ackmen silt loam, 0 to 6 percent slopes	26	IIIc-3	8	Upland Loam	16
AsC2	Ackmen silt loam, 0 to 6 percent slopes, moderately eroded.	25	(2)		Upland Loam	16
AsC3	Ackmen silt loam, 0 to 6 percent slopes, severely eroded.	26	(2)		Upland Loam	16
AyG	Ackmen silty clay loam, moderately deep over gravel, 2 to 25 percent slopes.	26	(2)		Upland Loam	16
BnD	Blanding very fine sandy loam, 2 to 10 percent slopes.	26	(2)		Semidesert Loam	20
HlC	Hovenweep loam, 2 to 6 percent slopes	27	IVc-3	10	Upland Loam and Upland Loam (Pinyon-Juniper).	16, 17
LHC	Lockerby and Hovenweep soils, 2 to 6 percent slopes.	28	IVc-4	10	Upland Clay and Upland Clay (Pinyon-Juniper).	16, 17
LHD	Lockerby and Hovenweep soils, 6 to 10 percent slopes.	28	(2)		Upland Clay and Upland Clay (Pinyon-Juniper).	16, 17
LMD	Lockerby and Menefee soils, 2 to 10 percent slopes.	28	(2)		Upland Clay and Upland Clay (Pinyon-Juniper).	16, 17
LyC2	Lockerby silty clay loam, 2 to 6 percent slopes, moderately eroded.	27	(2)		Upland Clay and Upland Clay (Pinyon-Juniper).	16, 17
MeG	Mellenthin very rocky fine sandy loam, 4 to 25 percent slopes.	28	(2)		Semidesert Stony Hills (Pinyon-Juniper)	20
MfG	Menefee clay loam, 2 to 25 percent slopes	29	(2)		Upland Shale (Pinyon-Juniper)	18
MfGC	Menefee cobbly clay loam, 4 to 40 percent slopes.	29	(2)		Upland Shale (Pinyon-Juniper)	18
MfGF	Menefee shaly clay loam, 2 to 25 percent slopes.	29	(2)		Upland Shale (Pinyon-Juniper)	18
MHD	Monticello-Hovenweep complex, 2 to 10 percent slopes.	30	IIIc-1	7	Upland Loam and Upland Loam (Pinyon-Juniper).	16, 17
MHDL	Monticello-Hovenweep complex, low rainfall, 2 to 10 percent slopes.	30	IVc-1	9	Upland Loam and Upland Loam (Pinyon-Juniper).	16, 17
MnD	Monticello very fine sandy loam, 0 to 10 percent slopes.	30	IIIc-1	7	Upland Loam and Upland Loam (Pinyon-Juniper).	16, 17
MnDL	Monticello very fine sandy loam, low rainfall, 2 to 10 percent slopes.	30	IVc-1	9	Upland Loam and Upland Loam (Pinyon-Juniper).	16, 17
MvG	Montvale very rocky very fine sandy loam, 2 to 25 percent slopes.	31	(2)		Upland Stony Hills (Pinyon-Juniper)	19
NlC	Northdale loam, 0 to 6 percent slopes	31	IIIc-2	8	Upland Loam and Upland Loam (Pinyon-Juniper).	16, 17
NlCL	Northdale loam, low rainfall, 0 to 6 percent slopes.	32	IVc-3	10	Upland Loam and Upland Loam (Pinyon-Juniper).	16, 17
NlD	Northdale loam, 6 to 10 percent slopes	32	IVe-1	8	Upland Loam and Upland Loam (Pinyon-Juniper).	16, 17
NlD3	Northdale loam, 2 to 10 percent slopes, severely eroded.	32	(2)		Upland Loam	16
NlDL	Northdale loam, low rainfall, 6 to 10 percent slopes.	32	(2)		Upland Loam and Upland Loam (Pinyon-Juniper).	16, 17
PsBW	Pack silt loam, moderately deep water table, 0 to 3 percent slopes.	32	(2)		Semiwet Meadow	15
PsC	Pack silt loam, 2 to 6 percent slopes	32	IIIc-3	8	Upland Loam	16
PsCC	Pack cobbly silt loam and silt loam, 2 to 6 percent slopes.	32	(2)		Upland Loam	16
SdD	Sandstone rockland, sloping	32	(2)		Upland Stony Hills (Pinyon-Juniper)	19
SdE	Sandstone rockland, steep	32	(2)		Upland Stony Hills (Pinyon-Juniper)	19
ShB	Shay clay loam, 0 to 3 percent slopes	34	IVc-2	9	Upland Clay	17
ShB3	Shay clay loam, 0 to 3 percent slopes, severely eroded.	34	(2)		Upland Clay	17
SnC	Scorup very fine sandy loam, 2 to 6 percent slopes.	33	IVc-1	9	Upland Loam and Upland Loam (Pinyon-Juniper).	16, 17
SnGC	Scorup cobbly very fine sandy loam, 2 to 25 percent slopes.	33	(2)		Upland Loam and Upland Loam (Pinyon-Juniper).	16, 17

See footnotes at end of guide.

GUIDE TO MAPPING UNITS, CAPABILITY UNITS, AND RANGE SITES [1]—Continued

Map symbol	Mapping unit	Page	Capability unit	Page	Range site	Page
UyB	Ucolo silty clay loam, 0 to 3 percent slopes	34	IVc-2	9	Upland Clay	17
UyB3	Ucolo silty clay loam, 0 to 3 percent slopes, severely eroded.	35	(2)		Upland Clay	17
UyD2	Ucolo silty clay loam, 2 to 10 percent slopes, moderately eroded.	35	(2)		Upland Clay	17
VcB3	Vega clay loam, 0 to 3 percent slopes, severely eroded.	35	(2)		Upland Loam	16
VcBW	Vega clay loam, moderately deep water table, 0 to 3 percent slopes.	35	(2)		Semiwet Meadow	15
VcC	Vega clay loam, 0 to 6 percent slopes	35	IIIc-3	8	Upland Loam	16
VcC2	Vega clay loam, 0 to 6 percent slopes, moderately eroded.	35	(2)		Upland Loam	16

[1] Table 7, p. 24, shows the acreage and proportionate extent of the soils mapped in the San Juan Area. Yields to be expected are discussed in the section "Crop Yields." Information about the range sites in the Area and yields of forage that may be expected on the various range sites can be found in the section "Range Management."

[2] Used mainly for range or consists of woodland used for range.

Soil Map - San Juan Area, Utah

U.S. Department of Agriculture, SCS
Utah Agricultural Experiment Station